THE TEACHERS' MANUAL OF OBJECT LESSONS IN ELEMENTARY SCIENCE AND GEOGRAPHY COMBINED

A COMPLETE SCHEME

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STANDARD I

LESSONS FROM COMMON OBJECTS

STANDARD I

Lesson I

WATER

Articles required for illustration: two small saucers, a basin, a tumbler, a small brush, a tray, a jug, a bottle, some saw-dust or sand, and a jug of water.

I. Water Flows

1. *Place two saucers on the table. Fill them to the brim very carefully—one with saw-dust, the other with water. Point out that the water and the saw-dust are both quite flat on the top, or level with the edge of the saucer.*

Now bring a child to the front, and let him pile up more saw-dust, a handful at a time, in the first saucer, till he makes it stand in a big heap above the edge.

This done, call upon the class to notice what happens when more water—only a very little—is put into the other saucer.

The water **will not stand up in a heap** as the saw-dust does. Some of it runs away over the edge of the saucer, and spreads itself about on the table. The top of the water in the saucer still **remains flat or level.**

Make a pile of saw-dust on the table itself or on a slate, and then try to do the same thing with water. Let the class tell what they observe.

The water again falls away, and **spreads about** over the slate.

2. *Explain that, because water spreads about in this way, we say* **it flows**; *and* **because it flows we call it a liquid.**

Saw-dust does not flow; it is not a liquid. It will stand in a heap, just as it is now, till we take it away.

Call upon the children to name things that flow about like water, such as milk, tea, vinegar, ink, and oil.

These things cannot stand in a heap, as saw-dust does: they flow about.

Water, milk, tea, vinegar, ink, and **oil,** are all **liquids.**

3. *Point out that we* **cannot pick up water** *in our hands, as we pick up the other things on the table. We cannot even scoop it up as the boy did the saw-dust.*

It would **run away through our fingers.**

This will naturally lead the children to understand, and help them to explain why it is that all the liquids they see are in bottles, glasses, basins, jugs, or vessels of some sort; and why there must not be the smallest hole or crack in the vessels, or the liquids in them would **ooze out** *and* **flow away.**

4. *Now empty the water slowly from the saucer into the basin, and call upon the children to observe and tell what takes place.*

When the saucer is tilted, the water in it cannot stand in a heap.

It falls over the edge, and **flows in a stream** into the basin.

We say the **water pours out.** We can pour liquids from one vessel into another, **because they flow.**

II. Liquids flow Down

Pour some water very slowly from one vessel into another.

Which way does the water flow? It flows **downwards.**

Let us see if we can make it flow upwards this time.

Place a slate on the table, pour a little water on it, and tilt one end, calling upon the children to notice which way the water flows now. **It flows down.**

Tilt the other end.

It is the same; **the water still flows down. It will not flow up.**

Call attention to the rain. Lead the children to tell that this water falls **from the clouds** *overhead* **downwards**; *it runs off the roofs of our houses* **downwards**; *it flows* **down the pipes, down the gutters, down the drains,**—*always down, never up.*

All liquids are like water in this—they **flow down**; they cannot flow up.

They flow simply because they are **always trying to get lower and lower down.**

III. Liquids break up into Drops.

1. *Dip a stick into a tumbler of water, and hold it up for the children to see that some of the water is hanging at the end of it.*

Shake the stick, and lead them to describe the shape of the little drop of water that falls from it. It is a **little round ball of water.**

2. *Dip a small brush into the water, and shake it over a greasy slate or a tray.*

Call upon the children to tell what happens.

The water falls from the brush in **little round drops,** which roll about on the tray.

3. *Now tilt the tray slightly, and let the children observe what becomes of the drops of water on it.*

They roll down the slope of the tray, **running one**

into another as they go, and flow in little streams to the lowest part of it.

But they are not separate round drops now. They have all joined together again **to make a little pool** of water at the bottom of the tray.

Show that this can be done quite as easily with either of the other liquids.

All liquids readily **break up into drops**; and **the drops run together** and unite again when they meet.

IV. Liquids have no Shape of their Own

1. *Call attention once more to the two saucers standing on the table.*

What is the shape of the saucers? **Round or circular.**

Now watch while I fill one of them very slowly with water. The water spreads out, and little by little fills the whole of the saucer, till the top of it is level with the edge.

What must be the shape of the water in the saucer now? The water is **the same shape as the saucer itself**—it is **round.**

Put some saw-dust into the other saucer, and let the children see that this does not spread out to fill the saucer, as the water did. It stands up in a heap in the middle. The saw-dust does not take the shape of the saucer.

2. *Now pour the water carefully out of the saucer into a variety of vessels, one after the other—a tumbler, a jug, a bottle, and an old meat-tin will serve the purpose—and lead the children to observe that in each case* **the water fills up every part of the vessel,** *and therefore* **takes the shape of it.**

Show too that the **water always keeps a level surface.**

We may slant the vessel as we please, but the water itself always stands level. We **cannot make it stand in a heap**; we **cannot make it slant.**

Summary of the Lesson

1. Liquids will not stand in a heap; they flow or spread about, and keep a level surface.

2. Liquids flow down. They flow because they are always trying to reach the lowest level.

3. Liquids break up into drops. The drops run together, and unite again when they meet.

4. Liquids have no shape of their own. They take the shape of the vessel which holds them.

Lesson II

LIQUIDS AND SOLIDS

Provide the following articles for illustration: a large stone, a block of wood, some sand and saw-dust, a saucer, some wax, an iron spoon, a spirit-lamp, a large pill-box, a piece of lead, a thimble, a pen-knife, some ice, and salt, a large basin, a small corked flask, and a jug of water.

I. Introduction

Refer to the lesson on water, and lead the class step by step to tell why they learned to call water a liquid.

(*a*) It flows about. It always flows down, never up.

(*b*) It breaks up into drops. The drops run one into the other again, if they touch.

(*c*) It has no shape of its own, but always takes the shape of the vessel that holds it.

(*d*) It cannot be grasped by the hand. It would run away between the fingers.

(*e*) It cannot stand in a heap, or on the slant, but always keeps a level surface.

II. Solid Bodies

1. *Lay a stone and a piece of wood on the table, and point*

out that these things will stand where they are placed till we remove them. **They will not flow away as water does.**

2. *Shake the stone and the wood. Notice that we cannot shake drops from these things as we did from the water in the brush.* **These things do not break up into drops when they are shaken.**

3. *Show the sawdust and sand. Elicit from the class that these things are little particles of wood and stone. Sprinkle some of each into saucers, and point out that* **the little particles do not run together,** *and unite into one piece again, as drops or particles of water would.*

4. *Let the children take the stone and wood in their hands. They can handle these things, but* **they could not pick up water,** *or any other liquid, in their hands.*

5. *Place the two things, one by one, in a saucer. Show that they stand up in a heap at the bottom of the saucer.* **They do not spread out to take the shape of the vessel** *in which they are placed.* **They have a shape of their own,** *and they keep it.*

Pour some water into the bottom of the saucer to make the contrast clear.

Show that **the water itself spreads out** *on all sides, to fill up the whole of the space between the stone and the rim of the saucer.*

Wood and stone are not liquids. We call them **solids.**

Solid bodies **do not flow; do not break up into drops; have a shape of their own;** and **do not take the shape of any vessel** into which they are put.

Point out that the ground we walk on is solid. We could not stand on the water of the pond.

III. Some Solids become Liquids

1. Here is a piece of wax. Is this a liquid or a solid? It is a solid.

Now I am going to put the wax into this large iron spoon, and hold it over the flame of the spirit-lamp. See what happens.

Point out that the wax, which at first stood in a lump in the middle of the spoon without touching the sides, soon **begins to fall away** *and spread out,* **till it fills the whole spoon,** *and* **takes its shape.** *Show too that* **it flows about** *in the spoon, and if it is held still,* **it keeps a level surface.**

What has happened then? The **solid wax** has been changed into **liquid wax.**

What has changed it? **The heat of the flame.**

Now pour the liquid wax out of the spoon into a large pill-box, and stand it aside to cool. Notice while doing so that this, like all other liquids, can be poured out.

2. *If time permit, the same thing may now be repeated with a piece of lead. Let the children see the substance in its liquid state, flowing about in the spoon. Like the wax,* **it is made liquid by heat.**

Pour the liquid lead into a little tin box, a thimble, or any other suitable thing ready to hand, and stand it aside with the wax to cool.

N.B.—*It would be advisable to fix the box and the thimble in holes sunk in a flat piece of wood, to avoid accidents with the lead.*

3. *While the wax and lead are cooling proceed as follows:*

Who has seen the long, pointed **icicles** hanging from the windows on a cold winter morning?

What are they made of? Ice.

Is ice a liquid or a solid? It is a **solid.**

Point out that we can pick up a piece of ice, and **throw it about** *from one hand to the other, without spilling any of it,* **without breaking it** *or* **altering its shape.** *We could not do this with any liquid.*

If we watch the icicles when the sun begins to shine on them, we see water dripping from them. Where does this water come from? It comes **from the icicles themselves.**

How is that? The sun shines on them and **changes the ice into water.**

What really happens to the ice? **It melts.**

Why does it melt? The **heat of the sun melts it.**

4. *Point out that this is exactly what happened to the wax and the lead in the two spoons.*

These things were changed, by the heat of the flame, from solids into liquids. We say the **wax and the lead were melted.**

5. *In connection with this the children should be led to think of the joint of meat roasting in front of the fire. They have all seen the* **solid fat** *of the meat* **melt into a liquid** *with the heat of the fire, and* **fall away in drops** *into the dripping-pan below. Lead them to talk about it now. The cook takes up the liquid fat in the spoon, and* **pours it** *over the meat to baste it while it is cooking.*

What does mother do with this liquid fat when the roasting is over? She pours it into a basin and leaves it to get cool.

IV. Melted Liquids become Solid again

1. Suppose we have a look at our melted wax and lead now. They must be cool by this time.

Hold up the pill-box and the thimble. Let the children handle them and discover for themselves that both are quite cool—that there is **no fear now of spilling** *any of the wax or lead in them.*

What has happened? These things are **no longer liquids,** as they were when we poured them out of the spoons. **They have become solid again.**

What made them liquid? **Heat.**

Why are they now changed back to solids again? **Because the heat has passed out of them,** and they are cool.

2. Let us see what else we can learn from this melting.

Cut the pill-box open very carefully with a pen-knife so as not to disturb its contents, and then call upon one of the children to open the box, and show what he finds inside it.

What have you got inside the box? A **round piece of solid wax,** exactly **the same shape as the pill-box** was, when the melted wax was poured into it.

Turn the lead out of the thimble, or the little square box, whichever it is, and the cold dripping-fat out of the basin, and show that all are alike. **The melted liquid** *in each case* **took the shape of the vessel** *into which it was poured.*

3. *The same thing may be shown in a very interesting way as follows:*

Pound some ice small in a mortar, mix it with an equal quantity of salt, and plunge into the mixture, before the commencement of the lesson, a small corked flask nearly full of water, taking care to see that the whole of the flask is covered up close. The water in the flask will freeze in about ten minutes.

When the flask is removed from the freezing mixture, break it (if it has not already burst in the act of freezing[1]*), and show* **the solid lump of ice inside.** *It is exactly* **the same shape as the flask itself.**

Summary of the Lesson

1. Solid bodies do not flow: they have a shape of their own, and they keep it.
2. Heat changes solids into liquids.
3. Ice is solid water.
4. Melted liquids become solid again when they are left to cool.

[1] Needless to say, the reason for the bursting does not concern us here.

Lesson III

THINGS POROUS

Provide the following articles for illustration: a large sponge, a saucer, a jug of water, a ball of lead, pieces of bread, salt, lump-sugar, pumice-stone, chalk, cane, soft wood, charcoal, coke, four small flower-pots, some sand and garden-mould, a new brick, a small pair of scales.

I. Meaning of the Word porous

1. *Place a large, dry sponge in a saucer of water, so that all may see, and then call upon one of the children to come out and take away the sponge. This done, turn the saucer up, and show that there is no water at all in it now.*

What has become of the water? It is **in the sponge.**

See, I will squeeze it all out into the saucer again.

Let us try the same with this ball of lead.

Does the water leave the saucer and go into the lead as it went into the sponge? No.

Now look at the sponge and the lead, and see if you can find out **why the water passes into the one** and not into the other.

There are **little holes all over the sponge,** but there are **no holes in the lead.**

Yes, and the holes are not only on the outside of the sponge, but **all through it.**

Cut a piece of it away and show the holes in it.

It is **full of holes.** These little holes are called **pores,** and because the sponge is full of holes, we say that it is **porous. Porous means full of holes.**

The sponge sucks up the water **because it is porous,** and the water **fills up the little holes in it.**

2. Here is a piece of bread. If I stand it in a saucer with only a little water in the bottom, I shall soon find

the bread **wet all through.** It will act just as the sponge did.

Look at the bread, and you will see that **it is porous, like the sponge.**

You can see the holes in it.

Show the pores in pieces of pumice-stone, cane, soft wood, coke, charcoal, or any other substance ready to hand. **These are all porous things.**

3. *Fill two flower-pots with dry garden-mould and sand respectively, and stand them in a shallow tray of water. Point out that* **the water** *gradually* **begins to disappear**—*that it gets lower and lower in the tray.*

Let two of the children turn the mould and sand out of the pots after a time, and they will see that both, instead of being dry as they were at first, **are now quite wet.**

While this is going on, half-fill two other flower-pots with mould and sand, and then fill them up with water. The children will of course observe the water trickle through the hole in the bottom of each pot.

Call upon them to explain.

The water soaks through the mould and the sand, **because these things are porous.**

4. *Take a common brick (a new one if possible); weigh it, place it in water, and after a short time take it out and weigh it again. It weighs heavier than it did at first, because of the water it holds.* **The brick is porous.**

II. The Pores are not always to be seen

1. Here are two lumps of chalk. I am going to weigh them in these scales. I put one into each scale-pan. See, they are **exactly the same weight;** the scales are level.

Now I drop one of them into this basin of water, and leave it there for a minute or so.

That will do. I will now take it out, and put it in the scale again.

What happens? The scale goes down.

What does that show? It shows that **the chalk** which has been taken out of the water **is heavier** than the piece in the other scale. It is heavier than it was, before it was put into the water.

What makes it heavier? **It has sucked up some of the water** out of the basin. It is **the water** in the chalk that **makes it heavier** than it was.

Think of the sponge and the bread once more. They sucked up water. Why? **Because they are porous.**

Then what kind of substance would you expect the chalk to be? A **porous substance.**

2. Take the dry piece of chalk in your hand, and see if you can find any pores in it, such as we saw in the sponge.

You cannot find any; but I will show you that there are pores in the chalk, although you cannot see them.

Place the dry piece of chalk on a plate containing a little coloured water, and hold it before the class so that they may see the coloured liquid rising through the white substance.

The pores in the chalk are **so small that we cannot see them**, but we know now that they are there, because we see the water rising in them from the plate.

Chalk, then, is a porous body.

3. *The same experiment may now be shown with a piece of lump-sugar or a piece of salt.*

We cannot see the pores in the sugar or the salt, but we find that if we lay these things on a wet surface, **the lump becomes wet through** in a short time; and if we use coloured water, we can actually see the water gradually rise, as we did in the chalk.

III. Absorbents

1. Porous bodies, we have seen, have the power of **sucking up water** through their pores.

Now I want you to remember a long word, which you can use instead of saying that these things **suck up water.**

The word is **absorb**. It means the same thing. All porous bodies **absorb,** *i.e.* **suck up** water through their pores; and because they do this we call them **absorbents.**

Call attention to some common substances, which are very useful to us, only because they are porous *and* absorbent, e.g. *blotting-paper, because it* **sucks up** *or* **absorbs** *ink; sponge, because it* **sucks up** *water or other liquids, and can hold them in its pores.*

2. *Next show that some are equally useful to us* **because they are not porous** *and* **not absorbent.**

What would be the use of a porous vessel for holding liquids? None; the liquids would all trickle through the pores of such a vessel and be lost. We therefore use glass, horn, silver, earthenware or china vessels, for this purpose, **because they are not porous.**

Why do we wear leather boots? Because **leather is not porous,**[1] and **does not absorb water.** The leather therefore keeps our feet dry in wet weather.

SUMMARY OF THE LESSON

1. Porous things are full of holes.
2. We cannot see the pores in some porous things.
3. Porous things absorb or suck up liquids.
4. Vessels for holding liquids must not be made of porous substances.
5. Porous material would not do for our boots and shoes.

[1] This, although not strictly true, is quite sufficient for our present purpose. It would apply, of course, with more truth to india-rubber galoches—india-rubber being absolutely non-porous.

Lesson IV

THINGS THAT FLOAT

The teacher should be provided with inch cubes of cork, oak, stone, and lead, a large basin of water, a hollow india-rubber ball, a jug of water, some olive oil, a bottle, some tar, powdered chalk, fine sand, and garden mould, and a thin, flat piece of board.

I. Light and Heavy Things

1. *Produce the cubes of cork, oak, stone, and lead, and without saying anything about them, drop them one by one into the water, calling upon the children to watch and observe what happens.*

They see that two of the cubes at once **sink to the bottom** *of the water and remain there, while the others* **rest near the top.**

Push these two down to the bottom of the water with the hand, and show that, immediately they are left to themselves, **they fly up to the surface again.**

They will not stay with the other two at the bottom of the water.

2. Now let us try to find out the reason for this. We will remove all four things from the water, and place them on the table side by side.

Look at them one by one as they stand there. What can you tell me about their shape? They are all **the same shape.**

What about their size? They are all **the same size.**

So far our eyes tell us that all four things are alike. But we know they must be different in some way because they act differently. As our eyes will not tell us what we want to know, we must try to find out in some other way.

3. *Bring a child to the front, instruct him to extend his hand*

at arm's length, and then place the four cubes in his open palm one by one, commencing with the cork.

While this is being done lead him to discover, **by the sense of feeling alone,** *that there is an important difference between them, which we could not find out by looking at them.* **One feels heavier than the other.**

Let him tell how he learns this. **He feels the weight pressing down upon his hand**; *some of the things press more than others.*

It will be an easy matter for him to pick out the stone and the lead as **the heavy things,** *and the wood and cork as* **the light ones.**

4. *This done, let him put all four cubes back into the water once more.*

Which of them are on the top of the water now? The **wood** and the **cork.**

Are they light or heavy? **Light.**

What has become of the heavy things — stone and lead? They are **at the bottom.**

What have you learned from this? That **heavy things sink in water; light things float on the top.**

II. Light Things float High

Call attention to the cork and wood once more. Lead the children to discover that although both things float, they do not rest on the top of the water, as they would on the table.

Some part of each of them is **actually in the water.**

Let them compare the two, and they find that the **wood sinks deeper** *in the water than the cork—that the* **cork rides higher** *out of the water than the wood.*

Which of these is the lighter body? **Cork is lighter than wood.**

What do we learn from this? We learn that **the lighter a thing is, the higher it floats** out of the **water.**

Throw a hollow india-rubber ball on the water, and show that this rests on the very surface. It floats even higher than the cork. **It is lighter than the cork.**

III. Liquids which Float

Fill a bottle with water coloured with a few drops of red ink, and pour a little oil into it, calling upon the children to tell what they observe.

Where is the oil? **It floats on the top** of the water.

Let us give the bottle a good shaking to mix the oil and the water well together.

What do you notice now? The oil is rising to the top again in little round balls. **It will not remain at the bottom.**

What do you learn from this? **Oil is lighter than water**; it floats.

Take another bottle of water, and pour a few drops of tar into it.

Note that **the tar at once sinks to the bottom.** *It does not attempt to rise when the bottle is shaken.*

Why is this? Because **tar is heavier than water.** The heavy body sinks.

Prove this by passing round the class two vessels of equal size, one filled with water, the other with tar.

IV. Mud and Sand

Fill three tumblers with water and put some powdered chalk in the first, some fine sand in the second, and some garden mould in the third.

Stir the three up for a time, and then call upon the class to observe what happens when they are left to themselves.

1. As long as the water is moving, the sand, chalk, and mould **float about in it.**

2. The sand is the first to sink to the bottom when the water becomes still. **It is heavier than the chalk and the mould.**

3. The chalk and mould are a long time in settling. When they settle at the bottom the water becomes clear.

We learn from this that some things—like sand, chalk, and earth (mud)—which **sink in still water,** are kept afloat **as long as the water is moving.**

V. Why Things Float

Set one of the children to press a broad, flat piece of cork or wood down into a bowl of water with his hand, and tell what he observes.

The water seems **to press** or **push the wood up,** as he presses it down.

As soon as he lets go, **the wood rises to the top** again.

Explain (1) *that* **the water is actually pressing upwards.** *The upward pressure of the water is greater than the weight of the wood pressing downwards. When the wood is left to itself* **the water presses it up,** *and makes it float.*

(2) *That the water presses upwards against heavy bodies too, but* **the downward pressure of their weight is greater than the upward pressure of the water,** *and so they sink.*

Summary of the Lesson

1. Light things float in water ; heavy things sink.
2. The lighter the thing is, the higher it floats out of the water.
3. Oil floats in water, tar sinks.
4. Some things float as long as the water is kept moving, but sink to the bottom when the water is still.
5. Things float because the water presses or buoys them up.

Lesson V

AIR

Provide the teacher with: a large basin, a can of water, a flask, some small stones, a piece of glass-tubing, a dry sponge, a large, well-corked flask fitted with an air-tight glass and india-rubber tube, with a spring clip for closing it at will, a good pair of balance, the Bunsen burner, or a spirit-lamp, a sand bath, a fan, a pair of bellows, a few feathers, little pieces of paper and other light things to lay on the table, a toy boat.

I. Air takes up room

1. *Fill a small flask up to the brim with water; and then call upon the children to notice what happens if we try to pour more water into it.*

Drop a few stones into the flask, and point out that the same thing happens. **The water overflows in each case.**

Why is this? The water takes up all the room inside the flask. There is no room for anything else, because the flask is full of water. **Some of it must flow out to make room for the stones.**

2. Now I will pour all the water and the stones out again, and you will perhaps tell me that the flask is empty, for we cannot see anything in it. Let us find out whether it is really empty.

Plunge the flask, mouth downwards, in a vessel of water, and point out that the water inside the flask is **not on a level with that all round it.**

It rises only a little way up the neck. **We cannot force the water up into the flask itself.**

Why cannot we make the water go up into the flask? I will show you.

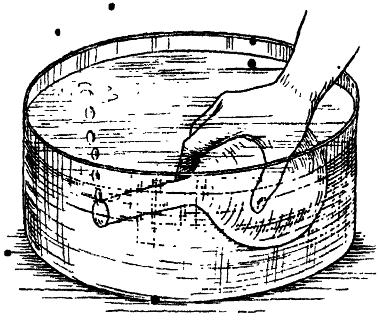
3. *Slant the flask on one side, and call attention to the*

sudden gurgling sound *that follows. Notice too* **the bubbles** *that rise up through the water.*

Something is passing out of the flask, and **as this something passes out,** the water rushes in. The flask is now full of water.

What is this something that came out of the flask? It is **air.**

We cannot see the air, but the flask, which you said



was empty, **was really full of air**—so full that **there was no room for the water to get in.** It was the air from the flask that **made those bubbles** when we slanted it.

4. *Repeat the experiment with a piece of glass tube, closing one end with the finger or thumb, and plunging the open end into the water. Show that the same thing happens again. The water will not rise in the tube* **because the tube is full of air.** *Slant it to* **let the air-bubbles escape** *as before, and then show that the water at once rises in the tube.*

Now plunge the tube in again without closing the top. This time the water inside the tube stands at the same level as that all round it.

Why? Because, as the water enters the tube below, **it drives the air out at the top** to make room for it.

5. Here is a dry sponge. What will happen if I put it into water? It will suck up the water till all its pores are full; sponge is porous and absorbent.

Take the sponge now, and force it down below the surface of the water, calling upon the children to observe carefully what takes place.

They see **bubbles rising up through the water.** *Elicit from what they have already learned (a) that* **these bubbles are caused by air**; *(b) that* **this air must have come out of the sponge**; *(c) that* **the water forced the air out** *of the pores of the sponge to make room for itself.*

Sum up what has been done by impressing upon the children (a) that not only is there air in the pores of the dry sponge and in the "empty" flask, but that **there is air everywhere**; *(b) that* **this air,** *although we cannot see it,* **is as much a real thing** *as water, stones, and other things we see around us; and (c) that* **air,** *like all other things,* **takes up room.**

II. Air has Weight

1. *Let one of the children hold a basin in his hand while it is filled with water, and call upon him to tell what he observes.*

The basin feels heavier than it did before the water was poured into it.

What do we learn from that? We learn that **the water weighs something.**

Show that it would be the same if we filled the basin with stones, sand, or anything else, for all those things weigh something.

2. *Now produce the air-tight flask. Remind the children that, although the flask looks empty, it is not really empty*—**it is full of air.** *All the room inside the flask is filled with air.*

Weigh the flask, and carefully note down its weight on the black-board.

Then proceed to remove some of the air, either by sucking it

through the tube, or heating the flask over the spirit-lamp or the Bunsen burner. This done, close the tube by means of the spring clip, and when the flask is cool weigh it again. **It weighs less now.**[1]

Why is this? Because **some of the air has been taken out.**

What does that tell us? It tells us that **air,** like water and other things, **weighs something.**

III. Air can be Felt

1. *Set one of the children to move his hand about in the water. He can feel the water as well as see it.*

Now let them all wave their hands to and fro in front of them, and lead them to tell that they **can now feel something,** *which they could not feel while they sat still.*

Explain that this **something which they can feel is air;** *that there is air all round us, although* **we do not feel it till we make it move.**

2. *Give one of the children a fan, and let him wave it to and fro in front of the rest. All will feel the air plainly enough then.*

Blow the bellows against their hands.

Air, then, like water, is something **which can be felt;** but we do not feel it till we set it moving, as we did with the **fan,** the **bellows,** and **our hands.**

3. How do we know that the air really moves?

Wave the fan to and fro again near the table, so as to make the feathers, pieces of paper, and other light things that are lying on it, fly about.

The fan moves the air; the air moves the pieces of paper and other things.

Put the toy boat into the water, and send it along by blowing with the bellows against its sail.

[1] *N.B.*—A cubic foot of air weighs about one ounce.

The **bellows moves the air**; it is **the moving air** that **moves the boat along.**

SUMMARY OF THE LESSON

1. There is air everywhere although we cannot see it.
2. Air is a real thing and takes up room.
3. Air, like every other thing, has weight.
4. Air can be felt when it is moving about.
5. When air moves it makes other things move.

Lesson VI

HARD AND SOFT THINGS

The teacher will require a wooden ball and a ball of worsted the same size, two potatoes—one boiled and one raw, pieces of bread, moist clay, putty, dough, sponge, stone, wood, iron, lead, glass, soap, wax, cork, steel, chalk, flint, an apple and a turnip, a knife, a file, a rasp, and a glazier's diamond if it can be obtained.

I. A SIMPLE TEST (PRESSURE).

ONE of the first ideas to strike a child, as he comes into contact with various objects, must be the difference in touch between one and another. It will be the aim of this lesson to enlarge the idea so as to enable the child to express clearly—

(*a*) What he understands by "hard" and "soft."

(*b*) Why this hardness and softness are relative terms.

(*c*) How he can test bodies for himself and so on.

1. *Call one of the children to the front. Place a wooden ball in one of his hands, and a loose ball of worsted in the other. Instruct him to squeeze both balls and then lead him to tell the result.*

Can you make the wooden ball smaller by squeezing it? No.

How does it feel? It feels hard. **I cannot squeeze it.**

Can you make the other ball smaller? Yes.

How does this ball feel when you squeeze it? **It feels soft.**

2. *Take away the worsted ball and give him a boiled potato to hold in place of it. Instruct him to squeeze the wooden ball and the potato as before, and let the class watch what happens. He cannot squeeze the ball. It is* **hard.** *The potato in the other hand squeezes up between his fingers as he presses it.*

The potato is **soft.**

Here is another potato: but this one is not boiled. It is raw. Try to squeeze that as you did the other one.

Can you do it? No.

What does that tell us? It tells us that this potato is **harder than the boiled one.**

3. Here is a piece of bread. Take the crust in one hand and the crumb in the other, and squeeze them.

He will tell that he can easily squeeze the crumb, **because it is soft**; *but he cannot squeeze the crust,* **because it is hard.**

4. *Show in a similar way—*

(*a*) *That such things as moist clay, putty, dough, sponge, paper, and cotton, woollen, silk, and linen materials are all soft. They* **yield to the pressure as we squeeze them.**

(*b*) *That other things like stone, wood, iron, lead, earthenware, glass, are hard bodies. They* **do not yield when we press them.**

II. Scratching and Cutting

1. **The Scratching Test.**—*Call another child to the front now, and let him try to scratch with his finger-nail some of the substances lying on the table, such as the pieces of soap, clay, wax, and putty, the apple, turnip, and potato, the cork, chalk, wood, lead, iron, flint, steel, and glass.*

Lead him step by step to tell what he observes.

(*a*) The apple, turnip, potato, clay, soap, and wax, he can **scratch very easily.** He can even **dig out pieces** of them with his finger-nail.

(*b*) The cork and the chalk he can also scratch, but **not so easily** as the others.

(*c*) The wood and lead he can **just scratch with his nail.**

(*d*) The iron, steel, flint, and glass he **cannot scratch at all.**

2. **The Cutting Test.**—*Let him next proceed in a similar way with a knife, commencing this time with the cork, and ask him to tell once more what he observes.*

(*a*) The cork and the chalk he **cuts easily.**

(*b*) The wood and the lead he cuts too, **but with more difficulty** than the cork.

(*c*) The iron, steel, flint, and glass he **cannot cut** with the knife.

(*d*) He **cannot even scratch** the flint, steel, and glass with it.

3. **The Rubbing Test.**—*Now let him take the different substances, and rub them one against another, and then call upon him to explain, as before. In this way it will be made clear that* **the harder body scratches, marks,** *or* **cuts** *the* **softer one.**

Now what have we learned by these tests?

We have learned—

(*a*) That although we call certain bodies hard and others soft, there are **many degrees of hardness.**

(*b*) That these terms of hardness and softness can only be used when one body is **set by the side of** (compared with) **another body.**

(*c*) Some bodies, which we call hard, are **really soft when compared with others.**

Make them tell that, **lead is hard when compared with wood or chalk, but soft when compared with**

iron; iron hard when compared with lead, but soft when compared with steel; *and so forth.*

4. *If time permit, illustrate this further by showing how a* **file** *and a* **rasp** *act.*

Why are these tools able to cut away pieces out of other hard substances?

III. The hardest Body known

Here is a piece of glass. You have seen that **I cannot cut it with this knife.** I could not cut it with the sharpest of knives, although **I can scratch it** with this sharp **flint.** The glazier cuts the glass easily enough, when he is putting a new pane in the window. But he does it with his diamond.

Diamond is the only substance that will cut glass. In fact it will scratch or cut every other substance. It is therefore the hardest substance known.

If possible, show the children a glazier's diamond, and point out to them the little bit of something that looks like clear glass at the end. It is this which does the work of cutting.

Show how it is done.

IV. Brittle and Tough

1. *Give one of the children some pieces of chalk and cork. Remind him that both these things are* **soft bodies.** *Set him to try to break them by beating them with a hammer.*

A slight tap with the hammer **breaks the chalk in pieces;** *but he* **cannot break the cork** *try as he will. The teacher tries with the same result.*

How is this? Both these things are so soft that **we can pick pieces out of them with our finger-nail,** and yet **I cannot break one of them** with the

hammer, although **the other crumbles up with a single blow.**

Suppose we try again with some of the hard bodies.

2. *Set the child to repeat the experiment with a piece of iron (not cast-iron of course), and pieces of glass and flint, all of which he knows are hard bodies.*

He **breaks the glass and the flint easily,** *but with all his hammering he* **cannot break the iron.**

We break the glass and the chalk easily, because although one is a hard body and the other a soft one, yet **both are brittle.** Glass and flint are **hard and brittle**; chalk is **soft and brittle.**

On the other hand we cannot break either the hard iron or the soft cork. They are **tough bodies.** Iron is **hard and tough**; cork is **soft and tough.**

3. We can write with chalk on the slate or the black-board, but the glass and flint would only scratch them. Why is this?

Conclude by asking the children to name other tough and brittle bodies, and arrange them on the black-board as hard and soft.

Summary of the Lesson

1. Soft things yield when we squeeze them; hard things do not yield.

2. Some things are so soft that we can scratch them with our nail; some are so hard that we cannot scratch them with the sharpest steel knife.

3. Hard things will scratch softer things.

4. Diamond is the hardest substance known.

5. Things which break easily are brittle.

6. Things which do not readily break are tough.

Lesson VII

A PIECE OF CLAY

Articles required for illustration: a lump of newly-dug common clay, and pieces of stone, sand, gravel, and chalk, specimens of Kaolin and other clays, a basin of water, a knife, a hammer, the clay balls, cubes, and bricks made during some former lesson, a piece of dough, a flower-pot, a lump of sun-dried clay.

I. Introduction

Produce one of the lumps of newly-dug clay, and proceed as follows:—

Who can tell me what this is? It is a piece of clay.

Where did it come from? It was **dug out of the ground.**

N.B.—*It is needless to say that all children must be quite familiar with this substance.*

They see it turned up wherever any digging is going on, for it is found almost everywhere.

Lead the children to name other things, besides clay, which they have seen dug up out of the ground, such as **stone, sand, gravel, chalk.**

Show specimens of each.

We have one name for all things of this kind which we get out of the earth. We call them minerals. **Clay** then **is a mineral.**

Let us see what we can learn about it.

II. Properties

1. **Brown Colour.**—Look at the clay as it lies on the table. Your eyes will tell you something as to its colour. It is of a **greyish-brown colour.**

If possible have specimens of other clay at hand, and show that all clay is not this colour—some kinds are **blue-black** *or*

slate colour, *some* **yellow,** *some* **reddish brown,** *and so on.*

Show the specimen of **Cornish clay** (*Kaolin*). *Tell that this is the* **purest form of clay,** *and it is* **white.**

Explain that the rougher kinds of clay, such as those on the table, get their colours from other things which lie near them in the ground.

2. **Heavy.**—*Let one of the children now take the piece of clay in his hand.*

What is the first thing you find out by handling it? The clay is **heavy.**

How could you prove that it is heavy? By putting it into the water.

Let him do so, and point out that the clay sinks to the bottom of the water.

What does this tell us? It tells us that the clay is heavy; **it sinks because** it is heavy.

3. **Feels smooth.**—*Set him next to take the clay out of the water, and rub his hand over it.*

What do you notice about the clay now? It **feels smooth and moist.**

4. **Soft.**—*Instruct him to take the clay in both hands and squeeze it; and then let him do the same with the stone. Elicit as before.*

Clay is soft. We can squeeze clay in our hands; **we cannot squeeze the hard stone.**

Do you remember any other way of finding out whether a thing is soft or hard? We can find out **by cutting it.**

Give him a knife and ask him to try to cut off a piece of the clay.

Clay is soft. It can be **easily cut** with a knife.

5. **Tough.**—*Illustrate further the softness of the clay by kneading, rolling, folding, and twisting the lump on the tray.*

Drop it on the floor, and beat it with a hammer, and point out that the clay changes its shape, but **does not break.** *Treat a piece of chalk in the same way.*

Clay is tough as well as soft; it **does not easily break.** Chalk is brittle; it breaks easily.

6. **Plastic.**—*Hand some pieces of the clay round the class now, and instruct the children to knead them up on their slates, as the teacher has already done.*

Let one of them work his piece up into a **ball**; *let another make a* **cube** *of his piece; set a third to make his piece into the form of a* **brick,** *and so on.*

Produce the similarly-shaped dried pieces made at some former lesson, and tell that these were shaped when they were soft, like those now in the hands of the children.

They have **kept the shape that was then given them**; those which have just been made would do the same, if we left them to get dry and hard. The **moist, soft clay** is said to be **plastic,** because we can **mould it into any shape** we please.

Show a piece of dough, or make some with a little flour and water, and repeat the experiments with that. Work it up into the shape of a biscuit, and compare it with an actual biscuit.

Dough like clay is plastic. Why?

The experiments may be further repeated with a piece of **soft wax** *or some* **putty.**

These things are plastic. Why?

7. **Not porous.**—*Shape one of the pieces of clay into the form of a basin, and fill it with water. Point out that* **the clay holds the water—none of it runs away.**

What happened when we poured water on the garden-mould and sand in those flower-pots the other day? The water ran away through the hole in the bottom of the pot.

Why? Because the mould and sand are porous; the water soaks through the pores.

Let us try the same thing now with some of this clay.

Point out that when clay is put into the flower-pot instead of

stand, **no water runs through.** *The clay keeps it all in as our clay basin is doing now.*

What do we learn from this? *We learn that* **clay is not porous.**

III. Dry Clay

1. *Produce the lump of dry clay now. Let the children take it in their hands and examine it. They will find that*

(*a*) *They cannot squeeze it in their hands, as they did the moist clay.* **Dry clay is hard.**

(*b*) *It does not feel smooth to the touch.* **Dry clay is rough and cracked on the outside.**

Elicit from this that it is the water in the moist clay that makes it soft and smooth to the touch. **The dry clay has no water left in it.**

2. *Scrape the dry clay with a knife, and show that* **it crumbles to pieces** *readily. Drop a piece of it, or strike it with a hammer.* **It breaks easily.**

Treat the moist clay in the same way.

Does the moist clay break? No.

Why not? Because moist clay is tough and plastic.

Then what shall we say about the dry clay? **Dry clay is brittle.**

3. *Now place the dry clay on a slate, and let water trickle on it slowly, a few drops at a time, calling upon the children to observe what happens.*

Where is the water? It has disappeared. It is not on the slate, for the slate is dry. **The dry clay has sucked it up.**

Let fall some more drops, and show that the same thing happens.

The water is in the clay. **The clay has sucked it up.**

How can we say this in another way? We can say that **dry clay absorbs water.**

Then what else can you tell me about this dry clay? **Dry clay** *must be* **porous.**

Look at this piece of dry clay, and tell me whether you can see the pores or holes in it. No.

Is it porous then? Yes, it must be porous **because it sucks up water.**

4. *Illustrate its greediness for water by letting one of the children put the piece of dry clay to his tongue, and explain what happens.*

The clay sticks to the tongue; it robs the tongue of all the moisture it can get, and is greedily sucking to get more.

Our piece of dry clay on the table will absorb a large quantity of water. It will suck up water till all its pores are quite full; **but after that it will not take another drop.**

Put a piece of the dry clay in water, and after leaving it there for a few minutes take it out, and show that it is no longer hard and brittle; it can now be kneaded up.

It has sucked up water; **the water has made it soft, tough, and plastic once more.**

Summary of the Lesson

1. Clay is a mineral, because it is dug out of the earth.
2. Clay is heavy, soft, tough, plastic, and not porous.
3. When clay is dry it becomes hard, brittle, porous.
4. Dry clay will absorb water till its pores are full; but after that it will not take in any more.

LESSONS FROM PLANTS

Lesson VIII

WHAT IS A PLANT?

Articles required for illustration: some specimen plants in flower, a few common leaves, a twig showing bursting buds, and some pieces of clay, chalk, and flint.

I. INTRODUCTION

CALL attention to the flower-pots on the table, and lead the children to talk about the "pretty flowers," as they will naturally call them.

Carefully avoid for the present any mention of the word **"plant."** *It will be best to commence from the child's own standpoint, and gradually deduce the new name as the lesson proceeds.*

Where do we see flowers? In the fields and parks and gardens.

Can we always find flowers there? No; there are **no flowers in the cold winter time.**

Explain, as the reason for this, that the flowers like warm, sunny weather; they do not like frost and snow.

Remind the children that as soon as the cold winter is all gone the flowers come again, and stay with us as long as the warm weather lasts.

We are going to see what we can learn about these beautiful things now.

II. ONE PART IS NOT LIKE ANOTHER

Lead the children to point out (a) that the specimens are

not all alike *in appearance, and (b) that each one* **consists of several distinct parts.**

1. **The Flower.** Come and show me the part in all of them which you like best.

What do we call this part? We call it **the flower** or **the blossom.**

Take the specimens one by one, and lead the children to point out (a) that each bears a particular kind of flower, **and none other**; *(b) that the flower of one is* **not like the flower of another.**

What is the first thing you notice? They are **not all the same colour.** Some are red, others are white, yellow, blue, and pink.

What else can you see? They are **not alike in shape and size.**

Now let us pick some of them, and examine them a little more closely.

Do so, and lead the children to observe, as they handle them, that they all have a **soft, smooth, glossy surface.**

Show how **delicate and tender** *they are. The least* **rough handling will bruise** *and tear them.*

Lastly, hand the specimens round the class for the children to smell. They learn from this new sense of smell that some of the flowers **have a delicious scent; others have no scent.**

2. **The Leaves.**—That will be enough about the flowers for the present. Suppose we turn to something else now.

Pluck one of the leaves, and hold it up before the class.

What is this? It is a **leaf.**

What colour is it? It is **green.**

Compare it with the other leaves, and lead the children to tell that they are all alike in colour, for **they are all green.** *They are* **not like the flowers** *in this respect, for flowers have many different colours.*

Set a child to find some other leaves exactly like this one.

Call upon the rest of the class to observe that he can find them on one of the specimens, but not on the others, and so lead them to tell :—

(*a*) *That each bears its own particular kind of leaf*, **and none other.**

(*b*) *That the leaf of one is* **not like the leaf of another** *either in shape or size.*

Hand a few leaves round the class now for closer inspection, and lead the children to compare them with the flowers they have already examined. Their sense of touch will readily show them that the leaf in each case, instead of being soft, smooth, and delicate like the flower, **is much thicker, coarser,** *and* **rougher.**

Show the reason for this by eliciting that the leaves have to **last longer than the flowers.**

3. **The Stem.**—*Pass on next to consider the part which stands up from the soil in the flower-pot. Explain that this is called the* **stem** *or* **stalk.**

Examine each specimen separately, and point out that one has **a single stem,** *another has several ; that the stem of one looks stouter and stronger than that of another, and so on.*

Tell that the purpose of the stem is to raise the leaves and flowers up **towards the light and air.** *Point out the little slender stalks, which join the leaves and flowers to the stem.*

We call these **the leaf-stalks,** and **the flower-stalks.**

Who has noticed the trees and bushes in the winter-time? They are bare then ; **they have no leaves.**

What do you see on them in the early spring? **Little pale-green knobs** here and there. They grow and swell bigger and bigger, until they at last burst out into actual leaves.

Who knows what we call these little green knobs, which grow into leaves? We call them **buds.** They are the cradles of the young leaves.

Show specimens of buds just bursting into leaf.

4. **The Root.**—We have spoken of the stem, the

buds, the leaves, and the flowers. Is not there some other part which we cannot see? Yes, **the root.**

Why don't we see the root? Because it is fixed and hidden away in the soil.

Turn one of the plants carefully out of the pot, and show this hidden part.

Point out that it is joined to the bottom of the stem, and **stretches down into the soil.**

III. Uses of the Root

1. *Call attention to the specimens once more. The leaves look fresh and green, and the flowers are bright and gay.*

What must we do if we want to keep them so? We must **water them.**

What would happen if we did not give them water? **They would die.**

Then do you mean to say that all these things in the flower-pots are alive? Yes, **they are alive now**; but **they would soon be dead,** if we did not give them water.

2. *Show a dead plant, and compare it with the living ones.*

This one died for want of water.

Where do we put the water? We pour it into the soil in the flower-pot.

What good does that do? Let me show you.

Turn a plant out of the pot, shake the earth from the roots, and call attention to this part.

Explain that it is the root, in every case, which keeps these living things alive. **The root sucks up food out of the soil to feed them.**

3. *Remind the children that the specimens in the flower-pots were not always as big as they are now. They were* **very small at first,** *but* **they grew bigger and bigger** *from day to day.*

Tell that, like other living things, **they cannot grow**

without food. The roots find food for them out of the soil, if we keep it moist.

Refer to the sponge, and its power of sucking up (absorbing) water into its pores. Tell that the root is something like a sponge in this. It **can suck up water,** *but* **it could not suck up the dry soil.**

That is why we must keep the soil moist by watering it, if the root is to find the food it wants.

4. *Lead the children next to think of the flowers in the garden in the wind and rain. Another purpose of the roots will then quickly force itself on their minds.* **The roots hold them firmly in the soil.**

Proceed, lastly, to gather up the teachings of the lesson one by one, and explain that things which **live and grow in the ground, get their food from the soil itself,** *and have a* **root, stem, leaves,** *and* **flowers,** *are called* **plants.**

Elicit therefore from the class that, not only the flowers in the flower-pot, but **trees** *and* **grass,** *and* **everything that grows in the ground, are plants.**

IV. Plants and Minerals

*Produce the pieces of clay, flint, and chalk. Remind the children that these things, like plants, come out of the ground. Ask for their name—***minerals.** *Break a piece off each of them, and point out that* **they have no distinct parts** *as plants have—that* **one piece is exactly the same as another.**

Call attention to the leaves, and other portions of the plants that have been broken off during the lesson. Notice that they are already wilted and withered.

Plants are living things. **The leaves, twigs, and flowers die,** when they are broken off from the living plant. **The plant itself would die if it were hurt.**

Prove this by cutting one of the plants just between the stem and the root. The plant will soon begin to show signs of flagging, and in a little while it will die.

Show how different it is with the pieces of flint, chalk, and clay that were broken off just now.

These things are minerals, **not living things; they never were alive.** They have not begun to wither; **they never will change.**

Conclude by leading the children to deduce from this, that as minerals are not living things, **they do not require to take in food from the soil to make them grow—** *that* **they do not grow in the ground as plants do.**

Summary of the Lesson

1. Things which live and grow in the ground are called plants.
2. Plants have several distinct parts, and one part is not at all like another.
3. The root feeds the plant with food which it sucks up out of the soil.
4. The root holds the plant firmly in the soil.
5. Minerals are not living things. They do not require food to make them grow.

Lesson IX

ROOTS

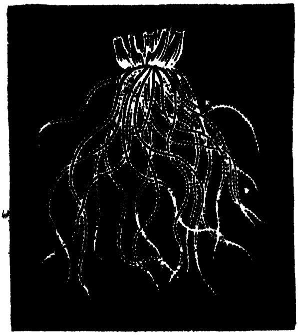
Provide the teacher with: a tuft of common grass or a daisy-root, a head of celery (if in season), some little corn-plants growing in flower-pots, a few simple annuals, a botanical lens, a carrot and a turnip, and pictures of all the other fleshy roots named. Grow three or four carrot-tops in saucers of water in preparation for the lesson, at intervals of eight or ten days between each one and the next. Nothing more is required except to cut off about an inch from the top, and stand the cut surface in the water.

I. Fibrous Roots

1. *Produce the tuft of grass; shake the root clear of the earth*

that clings to it, and lead the children to examine and describe it.

Elicit that the root is made up of **a great many strings, or threads,** *which stretch downward into the soil; that these strings are* **not green** *like the blades of grass themselves, but of* **a greyish-white colour**; *and that they make their way through the soil in search of food for the plant.*



2. *Tell the reason why the root is never green like the leaves.*

It is buried in the soil, and therefore **shut away from the light.** It is the **light that makes the leaves green.**

Prove this by showing a plant which has been grown in some dark cellar.

Show, too, **a head of celery,** *and explain how it was* **blanched,** *or made white.*

The leaves and stalks were green at first. When the earth was piled up all round them, **to shut them away from the light,** *they turned white.*

3. *Introduce the word fibre now. Tell that* **fibre** *is only another name for* **a thread** *or* **a string.**

We call roots of this kind **fibrous roots,** because they are made up of **threads** or **fibres.**

Show, as further specimens of these fibrous roots, some little **corn-plants grown in flower-pots** *for the occasion, and as many simple annuals from the garden as can be obtained.*

4. *Explain that when the farmer sows his corn in the fields, it springs up in green blades like these little plants in the pot, and* **lives only for one year**—*one season. If left to itself* **it**

would die down *as soon as it was ripe. It* **would not live through the winter.** *Instead of letting the corn-plants die down, the farmer cuts them down at harvest-time, because we want the ripe corn for bread.*

Remind the children of the seeds they sow in the garden in the spring. **The little plants** *that come from them* **live only one season.** *They die down when the winter comes.* **All plants that live for one season only have fibrous roots.**

N.B.—*The name* **Annual** *may be given to these plants, or withheld, according to the discretion of the teacher.*

5. *If time permit, it would be interesting to point out, with the aid of a good magnifying lens,* **the fine hairs** *which stand out from the fibres of these roots in all directions.*

Tell that these are known as the **root-hairs**; *they are the* **actual feeders of the plant.** *All the food which the plant takes in from the soil is* **sucked up by these tiny hairs.**

II. Fleshy Roots

1. *Produce the carrot now, and show the picture of the growing plant.*

Call attention to the green leaves above-ground, and also to the part which stretches downward into the soil.

This part is the root of the plant, but it is **a very different kind of root** from those which we have just been talking about.

What difference can you see? It is not made up of long strings or fibres; it is **all in one piece. It is not a fibrous root.**

Cut the carrot across, and show that it consists of **a thick, solid, fleshy mass** *all through. Tell that we call roots of this kind* **fleshy roots.** *Point out the* **root-hairs** *on its surface.*

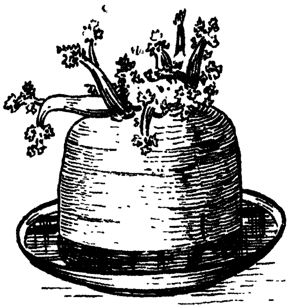
Let us now try to find out why there is this difference in roots.

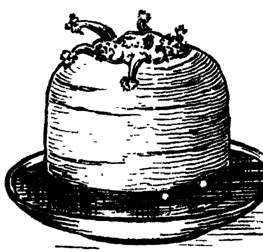
2. *Produce the growing carrot-tops. Select the most advanced specimen, and tell that it has been growing in the saucer*

of water for some weeks. The leaves are well formed and green.

Compare it with others in a less advanced stage, and point out the difference between the two.

Lastly, show a fresh-cut specimen, and explain that the other





was just like this when it was first put into the saucer of water. The leaves have grown out from the top of the root.

What do plants require to make them grow? **They require food.**

How do growing plants get their food? Their **roots suck it up** out of the soil.

But there is no soil in these saucers. There is nothing but water; and **water alone will not make plants grow.** How then have these carrot-tops been able to grow and send out new leaves?

Compare the fresh-cut specimen with the well-grown one. Lead the children to tell that the first is hard and solid throughout; the other is **loose, soft, and flabby.**

Explain that all this time the growing specimens **have been feeding on their own substance,** *and so the pieces of carrot themselves have been* **wasting away,** *and* **getting smaller** *from day to day.*

Tell that more and more leaves would continue to grow out till all the food-supply was gone, and then the **root part would appear withered up.**

3. Now let us see what we can learn from this.

If I were to sow some carrot seeds in my garden this season, I should get carrot plants growing up from them. These plants would grow all the season, but **when winter came round they would not die,** as many other plants do.

Their **green tops would die down,** but the thick, fleshy roots would **remain alive** in the ground all the winter. Then when spring returned once more, they **would wake up,** as it were, out of their winter sleep, and **begin to send out fresh green leaves.**

But what has all this to do with the large, fleshy root? That large, fleshy root **contains a store of food to feed the plant** when it begins to grow again after its long winter sleep, because it cannot then get its proper food from the soil.

4. *Show the parsnip, turnip, beet-root, and radish, and point out that all these are fleshy roots like the carrot.*

Notice the difference in shape. Compare the carrot and

parsnip with a cone, and explain that these are called **cone-shaped roots.**

Point out that the turnip, beet, mangold-wurzel, and turnip-radish are round, **something like a ball in shape.** *These are known as* **ball-shaped roots.**

Compare the long radish with both. It is not like either in shape; it is thick in the middle, and tapers towards both ends. Roots of this kind are said to be **spindle-shaped.** *Explain the reason for this name.*

5. All these plants not only take in enough food to keep them alive, and make them grow during the summer-time, but they also **store away, in their thick, fleshy roots enough food to live upon** till the next season.

The plants which live only one season have no need to store up food. They only want food from time to time during the growing season. That is why they have fibrous roots—not fleshy roots.

III. Some Curious Roots

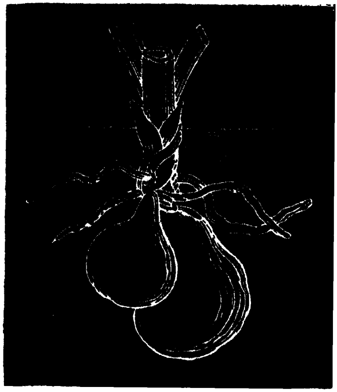
It would be well to show actual specimens of some of these fleshy roots, if possible, to illustrate the peculiar forms which they take, as they grow and swell in the soil. Of course the real things cannot all be obtained in the majority of cases, and therefore pictures must take their place, or the teacher must show them as black-board sketches.

Take first the **Dahlia root;** *and call attention to the* **bunch of long, fleshy tubers,** *with* **root-fibres at the end of each.**

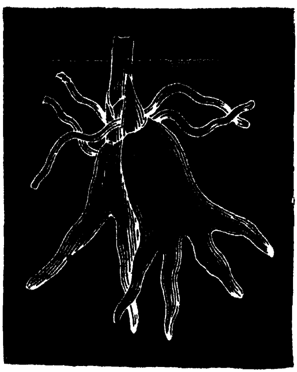
Show next some of the peculiar **orchid roots.** *The* **tubers of one kind**[1] *are*

[1] Orchis morio.

rounded or egg-shaped; those of another[1] *have the appearance of* **the fingers of an outstretched hand.**



It will interest the children to learn that the root-fibres of



plants which live more than one season often **swell into**

[1] Orchis maculata.

various forms, *such as these, and that the* **swollen root** *is in each case* **only a store of food for the plant to feed upon,** *till it can get its proper food from the soil once more.*

An examination of the **knotted roots of the drop-wort** *will show clearly that in every case it is* **the fibres of the root which swell.**

Summary of the Lesson

1. Plants which live only one season have fibrous roots.
2. Some plants have thick fleshy roots; they live for more than one year.
3. Some of these fleshy roots have strange shapes—there are cone-shaped, ball-shaped, and spindle-shaped roots, and there are others like knotted cords, others like the outstretched fingers of the hand, and others again egg-shaped.
4. All these fleshy roots contain a store of food to feed the plant when it cannot get its proper food from the soil.

Lesson X

STEMS

The teacher will require: a few simple annuals, one or two fresh-cut slips from some woody stem, two scarlet bean-plants growing in flower-pots (one without a stick), pictures of the hop, honeysuckle, and bindweed, a piece of vine-stem, and pictures of the other climbing stems, a strawberry plant growing in a small box, growing specimens of couch-grass, bindweed, and garden mint.

I. Green and Woody Stems

Show a few simple garden annuals, and explain that to-day our lesson is to be about the stems of plants.

Elicit that these plants live only one season—that they grow up from seeds in the spring, and **always perish before the**

next winter—*and from this lead the children to see that, such plants* **have no need of stout, strong stems.**

Point out that in each case the stem or stalk is **green, soft,** *and* **tender.**

Elicit next that in many of the plants, which live more than one season, it is **only the part in the ground that lives** —*all the rest of the plant above-ground dies down in the winter. These plants again have* **no need of thick, stout stems.** *Their stems are* **soft and green,** *almost like those of the annuals.*

All plants which have **green stems, that die down to the ground in the winter,** are called **herbs.**

Compare them with **trees, shrubs,** *and* **bushes,** *which live for many years. These have* **hard, woody stems.** *Show some fresh-cut specimens.*

II. Slender Stems

1. *Point out that the green stems of many of the herbs, although not hard and woody, are strong enough* **to stand upright or erect.**

They seem to be pushing their way upwards, so as to bring the leaves and flowers more and more into the power of the sunlight and air. **No plant can be healthy without light and air.**

2. Now look at the plant which I have here. I have grown it in this pot for your lesson.

Who can tell me what it is? It is a **scarlet bean-plant.**

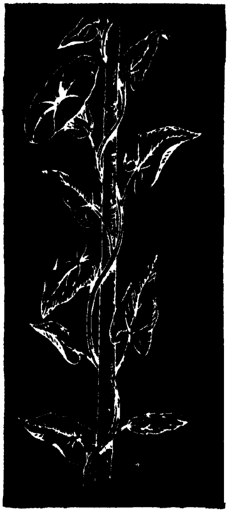
Look at the stem. What can you tell me about it? It is **thin, green,** and **soft.** I have kept this tall stick standing in the pot since the plant began to grow. Who knows why? The stick is to **support the plant.**

Lead the children to point out that, as the plant grows, it **twists** *or* **twines its stem** *round the stick. Explain that for this reason we call it a* **twining plant.**

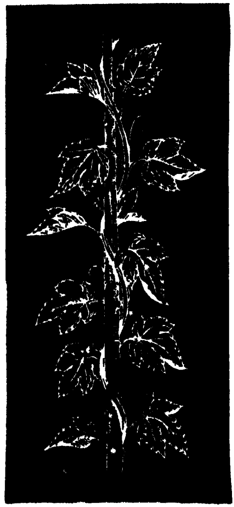
Show another which has been allowed to grow without a

stick, and tell the children to explain why some such support is necessary for a plant of this kind, to save its delicate stem from getting bruised and broken, and to help it to push its way upwards. **Without it that weak slender stem could not hold itself up.**

Specimens or pictures of other twining plants, such as



BINDWEED.



HOP.

the **hop, honeysuckle,** *and* **convolvulus** *or* **bindweed,** *should be shown.*

Notice that the bindweed **always turns to the right.** *Unwind it and force it the other way round the stick (to the left), and let the children observe* **how it resumes its old direction again,** *holding the stick with one of its leaf-stalks to get a purchase for the change. The* **hop always twines in the opposite direction.**

3. Who has seen a grape-vine growing?

Does it grow like a rose tree in the middle of the garden? No, it generally grows up the side of a wall.

Show a piece of a vine-stem, and call attention to the **little, green, curling tendrils.** *The specimen should show the tendrils clinging tightly round some twig. Let the children examine them for themselves. Tell the name, and explain the purpose they serve.*

Plants which cling to other things for support **by means of tendrils** are called **climbing plants.**

Compare with a boy climbing a tree.

A **sweet-pea** *in a flower-pot, and a sprig of* **Virginia creeper,** *should be shown as other examples of these. Pictures of the* **passion-flower, cucumber, melon,** *etc., should also be provided.*

Show a sprig of **ivy.** *Tell that this too is a* **climbing plant,** *and remind the children that it is usually seen growing up the sides of walls. Point out that this plant does not cling for support by means of tendrils, but* **by tiny rootlets,** *which actually force their way into the wall itself.*

III. Runners and Creeping Stems

1. *Produce the strawberry plant in the box, or, failing*

RUNNER OF STRAWBERRY.

the plant itself, show the picture, and lead the children to examine it.

Point out the **long, slender, green stems** *or stalks, which run along the surface of the soil. Tell that these are called* **runners.**

Notice that there is a little plant forming **at the extremity of each runner,** *with new leaves shooting upwards, and tiny rootlets making their way downwards into the soil.*

Tell that plants of this kind **grow by means of runners.** *They run along the ground for a short distance, and then* **form a new plant,** *with roots, leaves—every part—like the parent plant. Show from this the reason for the name* **strawberry,** *which really means* **stray-berry.**

A picture of the growing **violet** *might be shown as another example of these* **running stems.**

COUCH-GRASS.

2. *Take next the specimens of* **couch-grass, bindweed,** *and* **garden mint.**

Call attention to the **long, slender, white cords,** *from which the green parts above-ground, as well as the roots below, spring. Notice the* **buds here and there.** *Explain that this proves them to be stems, not roots; for* **buds never grow on a root.**

These cords are **actual stems,** like the runners of the strawberry plant; but instead of being green like those runners, they are **almost white.**

How can you account for that? They **must have grown underground in the dark.**

How do you know that? Because the green parts of plants **always turn white in the dark.**

Explain that **these white cords** *make their way* **under the ground,** *and send out buds here and there* **to form new plants,** *as the runners of the strawberry plant do along the surface.*

We call plants of this kind **creeping plants**; they **creep along under the ground.**

Summary of the Lesson

1. Plants that live only one season have soft green stems.
2. The stems of trees, shrubs, and bushes, which live year after year, are hard and woody.
3. Most plants with slender stems twine or climb round other things for support.
4. Some others run along the surface of the ground with runners.
5. Some creep along under the ground.

Lesson XI

STEMS (Second Lesson)

Provide for illustration pictures of the root-stock of Solomon's Seal, the common Iris, and the potato tubers. Grow also in preparation for the lesson, at regular intervals of about a week between each one and the next, some pieces of potato in saucers of water, and some onions in bottles. The onions will grow best if kept for the first week or two in a warm, dark cellar. Nothing more is required but to fill the bottle with water, and place the onion in the mouth of the bottle, so that it just touches the water. It will be necessary to add a little water from time to time.

I. Introduction

Commence with a brief recapitulation of the subject of the last lesson, leading the children to describe in particular the nature

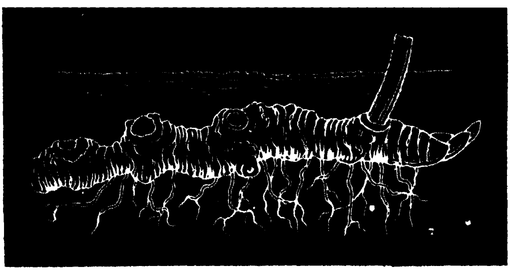
of the runners and creeping stems. Let them show clearly the difference between these stems and a root, by comparing the white cords of the couch-grass or mint with the strings of some fibrous root. Assist them to point out in the actual specimens, or on the picture, that these creeping stems and runners have a growing bud at their extremity, and that they grow a certain length, and then form new roots and new stems, which send up shoots to the surface. Roots never have buds.

II. Underground Stems

Now I want you to think for a moment about the thick, fleshy roots of our last lesson.

Why have some plants thick, fleshy roots, and others only slender threads or fibres? The thick, fleshy roots **contain a store of food** to feed the plant, when it cannot get its food from the soil. Plants with these fleshy roots **live more than one season.**

Explain that all plants of this kind do not lay up their food-store in their roots. Some **store it away in their**

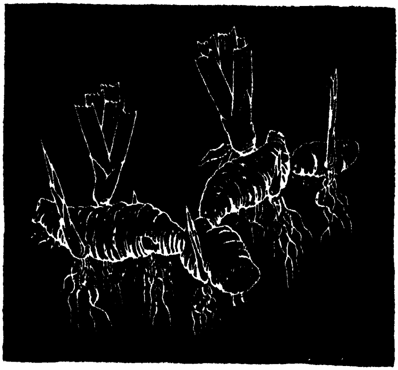


ROOT-STOCK OF SOLOMON'S SEAL.

stems, *and thus the* **stems become thick** *and* **fleshy** *instead of the roots.*

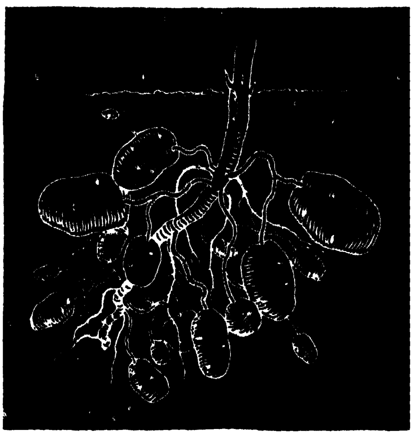
Show, as specimens of these fleshy stems, pictures of the **root-stock of the Solomon's Seal** *and the* **common Iris.** *Point out that they both look very much like roots. Tell that*

they are so much like roots that people often call them roots. They are commonly known as **root-stocks.**



ROOT-STOCK OF IRIS.

They are **not really roots;** they are **underground**



POTATO.

stems. They grow by creeping along underground, just

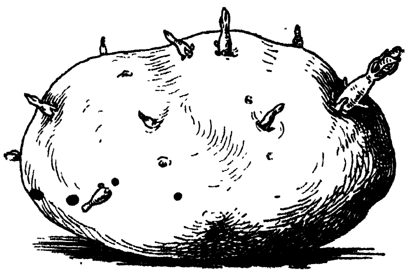
as those white cords of the couch-grass do. They send out stems and leaves above-ground from the upper surface, and root-fibres from the lower.

Call attention to the **bud at the end of the root-stock** *of the Solomon's Seal. Tell that this bud will grow up next year into* **a tall stem with leaves** *and flowers on it. Show this year's stem just behind it, and* **the scars** *which mark the spots where the stems of former years grew.*

Notice that the **Iris creeps along in much the same way,** *except that it sends out* **buds from the sides** *and not from the end.*

III. The Potato

Show next a good picture of the growing potato plant. The children will naturally speak of the potatoes themselves as **the**



roots of the plant, *because they see them growing in the ground.*

Give them an actual potato to examine, and lead them to point out the **"eyes."**

Tell that these **"eyes" are really buds,** *and remind them that* **buds never grow on the roots** *of plants.*

The **potatoes are not roots,** but **parts of the underground stems,** which have become swollen into these round balls. We call them **tubers.**

Show the specimen potato that has been growing in the saucer of water.

Notice that from each "eye" **a long whitish stalk, with a green bud at the end,** *has grown out; and that at the same spot a number of root-fibres may also be seen.* This is a little potato plant growing from the old potato.

What has made the potato grow? Where did it obtain the food that was necessary to make it grow? Why is the potato itself now shrivelled up and soft?

Lead the children in this way to see the purpose of these tubers as **store-houses of food for the plant.**

Tell how potatoes are grown in the fields from pieces of the tubers such as this. The young, growing plants which come from them **feed on the old tubers,** *till they are able to get their proper food from the soil.*

IV. Bulbs

Show an onion.

You all know what this is? It is an onion.

What have we on the under side of it? A great many **strings** or **fibres.**

What are these? **The roots of the plant.**

Then the onion itself cannot be the root? No.

This round-looking ball is really **the lower part of the stem swollen very big.** We call it a **bulb.**

Show a picture of the growing plant. Point out the fibrous roots stretching down into the soil, and the stem rising upwards from the thick, swollen bulb.

Tell that when the autumn comes, the rest of the stem dies down, and **only the bulb is left.** *If we put this into the ground the next spring, it would send out a new stem and leaves above, and new root-fibres into the soil.* **It would spring up again into a new plant.**

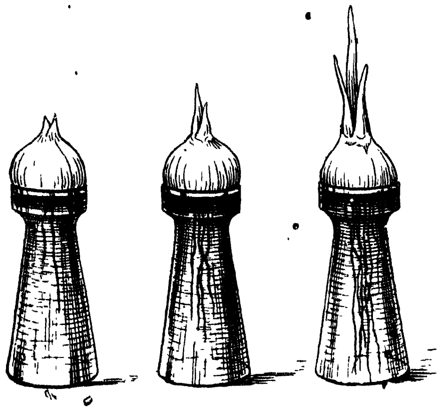
Produce the onions now that have been grown in the bottles of water. Notice that the most advanced specimen has sent out quite **a cluster of root-fibres,** *which stretch down into the water, and that the stem is also making good headway above.*

Point out that the others are growing too—they were put in later.

In the latest of all, the root-fibres are just pricking through the bottom of the bulb.

Compare this bulb with the one which has made the most growth. The latter is **soft, flabby, and wasted,** *while the former is as hard and solid as ever.*

What is the meaning of this? The stem of the onion



becomes swollen out into a thick, fleshy bulb as it grows, because **this plant is meant to live more than one season,** and it **stores up its food-supply in the bulb.**

The onions growing in the bottles **have been feeding on the food stored up in the bulbs.** That is why they appear wasted.

The **lily, leek,** *and* **hyacinth** *might be shown as further specimens of these bulbous stems.*

SUMMARY OF THE LESSON

1. Underground stems are often thick and fleshy. They contain a store of food for the plant.

2. The potato is not a root, but part of the underground stem, which has become swollen into tubers as a store of food to feed the plant.

3. The eyes are buds in the tubers.

4. *Bulbs are the lower part of the stem swollen very large. They contain a store of food for the plant.*

Lesson XII

LEAVES

Provide for illustration: a good collection of leaves of various kinds, a familiar growing plant of some sort in a pot, twigs of the lime, oak, or elm, common hop, dead-nettle, lilac, fuchsia, and laurel. A collection of autumn-gathered leaves pressed in a blotting-paper scrap-book would be found very useful. Of course where actual specimens cannot be obtained, good pictures must take their place.

I. Parts of a Leaf

Hand a few simple leaves round the class for inspection. Elicit that each of these leaves consists of two distinct parts.

Who can point out the two parts? There is first of all the **thin, flat, broad part.** This we call the **blade.** Then there is the **long stalk** which joins the blade to the twig or branch. This is the **footstalk.**

N.B.—*The stipules of the perfect leaf have been purposely omitted here. They may be dealt with in a more advanced lesson. The blade and footstalk will be quite sufficient for our present purpose.*

The blade is of course the most important part of the leaf. It is this part which we have in our mind when we speak of a leaf. Let us see what we can learn about it now.

II. The Nature of the Blade

1. **Shape.**—*Call upon the children to examine their specimens, and compare them one with another as to size and shape. They will at once see that there is considerable difference in both these respects.*

Passing over the more obvious difference in size, call particular attention to a few of the varying shapes of the leaves.

Point out that there are in the collection **round, oval, heart-shaped, oblong,** *and* **kidney-shaped** *leaves.*

Others bear a sort of likeness in form to some well-known object, and we name them accordingly **sword-shaped, lance-shaped, arrow-shaped,** *and* **needle-shaped** *leaves.*

Show each of these by the side of the object from which it takes its name, or sketch the two things on the black-board.

2. **Edges.**—*Now show the* **lime,** *the* **rose,** *and the* **strawberry leaves,** *and call attention to their edges. Let the children feel them, and compare them with a few of the smooth-edged leaves.*

Some leaves have smooth edges, others are **notched like the edge of a saw.**

3. **Surface.**—*Let the children next compare the leaf of a cucumber or a vegetable marrow with a cabbage leaf—a scarlet-runner leaf with an oak leaf.*

They will tell, by feeling the surface of each, that the cucumber, marrow, and scarlet-runner leaves are **rough to the touch,** *while the cabbage leaf and the oak leaf are* **smooth.**

Let them examine these rough leaves more closely, and lead them to point out that the roughness is due to the **short, stiff hairs** *with which they are covered. There are none of these hairs on the cabbage leaf.*

Have other rough and smooth leaves picked out from the collection.

4. **Upper and Under Side.**—*Call attention next to one of the growing plants on the table. Point out that the leaves all grow, as far as they can, with one side spread out towards the light, the other facing the ground. Each leaf has* **an upper** *and* **an under side.** *Instruct the children to observe carefully the leaves of other plants and trees from time to time. They will find that all are arranged on this plan.*

Let them now examine and compare the two sides of all their specimen leaves.

They will find that one side of each leaf is **darker in colour,** *and* **smoother to the touch,** *than the other side.*

Explain that this is **the upper side of the leaf in each case.** *The* **under side** *of some leaves is* **very rough.**

5. **Ribs.**—We will now have a good look at the under side of one of these leaves. Suppose we take this large **mallow leaf.** You will be able to see the parts as I point them out.

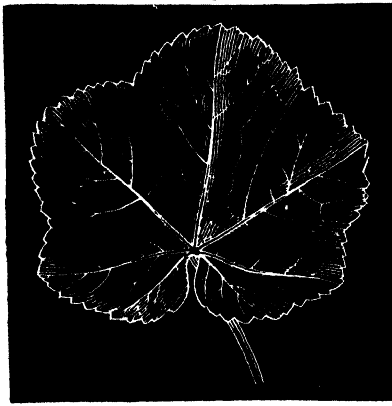
Let the following facts be deduced one by one from the class. The blade is **very large and broad,** *and it is* **very brittle;** *it would easily break.*

Now look at these **thick, stout supports,** that run from the stalk to the edge of the blade. There are **seven of them** altogether. They make a **strong framework to support the blade,** just as the framework of my umbrella makes a support for the silk covering.

Do you know what we call the framework of the umbrella? The **ribs.**

Yes; and we also call this framework of the leaf, its **ribs.**

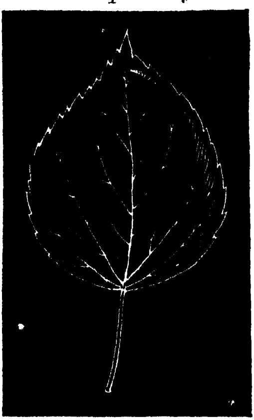
The ribs support and strengthen the blade, and keep it well stretched out to the light and air.



MALLOW LEAF.

III. Simple and Compound Leaves

Hold up one of the common, simple leaves—a **lime leaf** *will do as well as any—side by side with a* **leaf of the Virginia creeper.**



LIME LEAF.

Here are two leaves not at all alike in appearance. Can you tell me in what respect they are not alike? The first is made **all in one piece**; there is **only one blade.** The other has **several separate blades.**

Let the children select from their specimens other similar leaves with a single blade, such as those of the apple, pear, plum, cherry, rhubarb, oak, vine, nasturtium, geranium, etc.

Leaves of this kind are called **simple leaves.**

Now show some others, such as the leaves of the scarlet bean, clover, strawberry, rose, horse-chestnut, and Virginia creeper.

How are all these different from the simple leaves? They are made up of **several separate blades.**

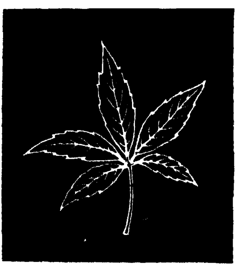
Let us see. We will take the leaf of the scarlet bean first.

Show that this leaf is really **in three parts;** *that there*

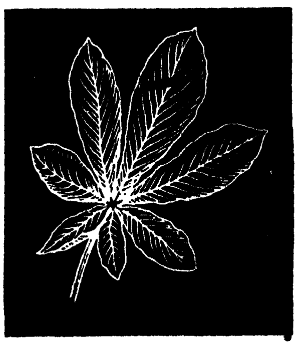
ROSE LEAF.

are three distinct blades, each blade having its own footstalk, which joins it to the main footstalk.

The three blades are **not three separate leaves,** but



VIRGINIA CREEPER.



HORSE-CHESTNUT.

three parts of one leaf. The three parts are not called leaves but **leaflets.**

Who knows what the word leaflet means? A **little leaf.**

Now take the clover and the strawberry leaf, and show that the arrangement in these two is very like that in the scarlet bean leaf, except that the leaflets have shorter footstalks.

The rose and the Virginia creeper will supply specimens of other leaves with five distinct leaflets. The horse-chestnut leaf has seven leaflets.

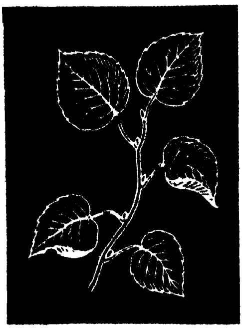
All leaves that **consist of several leaflets,** and not of a single blade, are called **compound leaves.**

IV. Arrangement

1. *Pass on now to notice briefly how the leaves are arranged on different plants.*

Lead the children to tell from their own observation (and confirm this, as far as possible, by means of specimens before the class), that—

(*a*) Leaves usually grow **on the twigs** or **branches** of the plant.



LIME TWIG.

(*b*) In some plants they grow **on the stem.**

(*c*) In others again they **spring direct from the root.**

Thus we have **branch leaves, stem leaves,** and **radicle** or **root leaves.**

2. *Hold up a small twig of the lime, oak, or elm, and call attention to the leaves on it.*

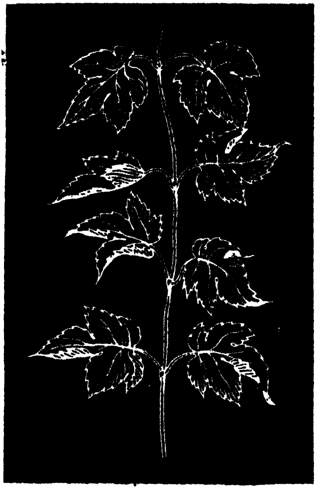
There are **joints in the twig** at regular intervals, and **a single leaf comes from each joint.** The leaves follow one another on **opposite sides** of the twig.

Tell that this is a very common arrangement, and ask the children to search for it themselves among the plants they meet with from time to time.

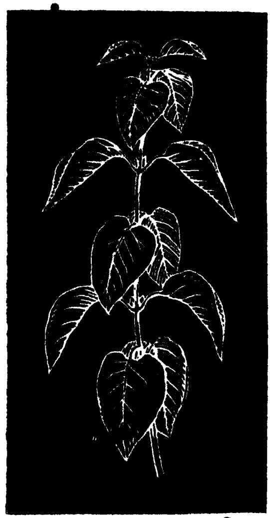
3. *Show next a piece of the stem of the* **common hop,** *or*

the **dead-nettle.** *Point out the difference in the arrangement here. The leaves as before spring from the joints, but instead of a single leaf, we find* **a pair at each joint, one exactly opposite the other.**

4. *A sprig of lilac, fuchsia, or laurel will furnish an illustration of a still further arrangement in which the leaves are*



HOP.



LILAC.

in opposite pairs, *but* **each pair follows the other at right angles**—*that is on different sides of the twig.*

N.B.—*The above are only some of the most common modes of arrangement, but they will provide sufficient scope for the children's observation at this early stage.*

V. Evergreens

Introduce these by showing a few leaves of ivy, holly, or laurel. Tell their names. Note their **smooth, glossy surface,** *and their* **dark green** *colour*

Contrast them with the leaves of the oak, lime, elm, and beech.

What do we always notice about the trees as autumn comes on? The leaves begin to **change colour**; then they **die** and **fall off.**

How do the trees look by Christmas-time? They are **quite bare** then, because all their leaves are fallen.

It would be interesting and highly instructive to collect and press in a book specimens of fallen leaves during the autumn. These might be shown now **in illustration of the changing tints** *which the leaves take as they begin to die and fall.*

Are there any trees at Christmas-time that do not look bare? Yes; the ivy, holly, box, myrtle, and laurel are **covered with green leaves all the winter.**

What do we call these? We call them **evergreens.**

Explain that these plants are always green, because the old leaves do not die off **until the new ones are quite formed.**

In this way these plants, unlike trees which shed their leaves in the autumn, are never bare.

Summary of the Lesson

1. A leaf consists of the blade and the footstalk.

2. The blade is supported by ribs which spring from the footstalk.

3. Simple leaves have one single blade; compound leaves have several separate blades.

4. Leaves are arranged differently on different plants.

5. The old leaves of evergreens do not fall till the new ones are quite formed.

Lesson XIII

FLOWERS

The teacher should be provided with specimens of all flowers named, and pictures to show all the parts of the flower in an enlarged form. An apple and a knife will also be

I. Introduction

Introduce the new lesson by calling attention to the fields in spring-time—bright and gay with daisies and buttercups, primroses, cowslips, and violets, and to the gardens all through the spring and summer, one mass of brilliant colours.

We like to look on the pretty flowers, because of their beauty, but besides pleasing our eyes, they have a most important work to do.

To-day we are going to learn something about the flowers and their work.

Who has seen an apple tree in the early spring covered with beautiful blossoms? **Those blossoms on the tree** are its **flowers.** We like to see plenty of flowers on the tree, because the flowers will one day die off, and leave the fruit behind.

II. The Flower-Leaves

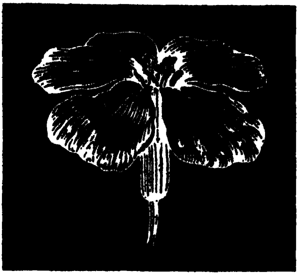
1. *Hand a few common, simple flowers round the class, for examination by the children. Call upon one child to examine his flower, and tell what he can of its appearance.*

His eyes will tell him that it consists of a certain number of leaves, **not coarse and green,** *like the true leaves of the plant, but* **very delicate** *and* **rich in colour.**

Comparing his flower with others in the class, he may tell that **there is a great variety in the colour of flowers.**

By handling the flower-leaves, he will learn something of their extremely **soft, smooth, and delicate nature.**

Proceed next to show, by comparing the flowers in the hands of the children, that these flower-leaves are **very curiously arranged.**



WALLFLOWER.

Lead them in the first place to discover for themselves that all flowers have **not the same number of flower-leaves.**

The **wallflower** and the **poppy** have **four,** the **buttercup, violet,** and **pansy** have **five**; the **tulip** and **lily** have **six.**

2. *Notice next that in all these, and in most other flowers, the flower-leaves are* **separate from each other**; *and then call attention to the* **convolvulus,** *in which the flower-leaves are seen to be* **joined together at their edges,** *so as to make a sort of* **flower-cup** *or* **bell.**

Among these bell-shaped flowers, in addition to the bindweed or convolvulus, are the **foxglove,** the **harebell,** and the various kinds of **heath** or **heather.**

FOXGLOVE.

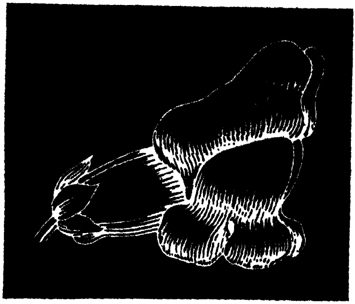
In some few of them the flower is lengthened out somewhat in the **form of a tube.**

Show, if possible, a **pentstemon** *as a sample of these tube-shaped flowers.*

3. *Produce a common* **snap-dragon,** *a* **white dead-nettle,** *or a* **sage flower** *next, and call attention to their shape.*

They are not like any of the other flowers. They are commonly called **two-lipped flowers.** *Let the children examine them and explain the fitness of the name.*

4. *Show a* **pea blossom.** *Point out that this again has*



SNAP-DRAGON.

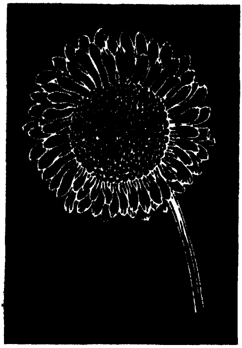
a shape of its own, *which is unlike that of any other flower.*

It is more **like a butterfly** in shape than anything else. It is called the **butterfly-shaped flower.**

PEA BLOSSOM.

Show and compare the flower with a butterfly, whose wings are raised in the act of walking.

5. *Lastly, produce a* **daisy,** *a* **dandelion,** *or a* **sunflower.** *It will interest the children to learn that, each of these consists of* **an immense number of little flowers,** *packed close together. Pull the specimen to pieces and show that it is so. Let the children examine the* **separated florets** *for themselves.*



THE DAISY.

III. Stamens and Pistil

1. *Tell that, beautiful as these flower-leaves are, they are not the most important part of the flower.*

Let the children strip off the flower-leaves carefully from their specimens.

Point out that the most important parts of the flower are seen after the flower-leaves have been stripped off.

Show that, it is because these parts are so important, that we find them placed in the very centre of the flower, **with the flower-leaves all round to protect them.**

It would be well to illustrate this stage of the lesson by means of a **lily,** *if possible, as its parts are large and can be easily seen by the class.*

2. Now let us see what we have inside. First of all look at these **long, slender stalks,** which stand upright from the bottom of the cup. There are **six of them,** and they **stand in a circle** round another and somewhat stouter stalk. Look at the top of each of the first six, and you will see there a **long, yellow-looking knob.**

Call upon one of the class to come and pick off one of these little knobs. When he has done so, ask him to look at his fingers, and tell what he sees there. He sees **some fine yellow dust.**

Those little knobs are really **little oblong boxes**; they are **full of this yellow dust.**

We call these stalks, with their little boxes full of yellow dust, the **stamens** of the flower; the yellow dust itself is called **pollen.**

3. *Now let all the stamens be stripped off, so as to leave* **the central stalk** *the only remaining part of the flower. Let the children examine it closely.*

Note the **upper rounded knob,** *and the* **lower swollen part** *where it joins the flower-stalk.*

We call this central part of the flower the **pistil.**

Look at its lower swollen part, while I cut it open. It is not a mere solid stalk; it is really **a wonderful little box** or **case.** Let us see what is inside this box, for you may be sure that as the box is there, we shall find something in it. It was not made without some useful purpose.

Cut it open now and pick out some of the **tiny seeds** *with the point of the penknife. Tell what they are, and let the children examine them.*

These are the **seeds of the plant. It is the work of the flowers to produce these seeds.** If the seeds in this little box had been left to grow to their full size, and get ripe, they would have made new plants next season, when they were put into the ground.

Notice **how wonderfully they are arranged** *in the little seed-box.*

Now lastly show an apple. Tell that this came from a flower—**the flower of an apple tree.**

Cut it open, and show the **core** *with its* **pips** *inside.*

What is this? It is only the **seed-box,** which came from the flower, and these pips are the **seeds.**

Without flowers there could be no seeds, and no new plants year after year.

Summary of the Lesson

1. All flowers have not the same number of flower-leaves.
2. Flowers have many different forms.

3. The stamens are little stalks which support the anthers.
4. The anthers are little boxes filled with pollen.
5. The seeds are formed in a little case in the middle of the flower.
6 It is the work of the flower to produce the seeds.

LESSONS FROM ANIMALS

Lesson XIV

THE CAT

Have ready for illustration: a living cat, and good pictures to show the structure, as it is described. The teacher should cultivate the power of showing the various parts by black-board sketches. Provide also a saucer of milk.

The purpose of this, the first lesson, is to deal with the structure of the animal, and such simple habits as must have come under the children's own observation.

The killing propensities and the habits dependent thereon will form the subject of the second lesson, and that will be the best time to show how completely the structure and habits of the animal, as a whole, are in harmony.

Ask one of the children to bring a quiet, gentle cat for the occasion.

Any child will be pleased to do this, especially if the request is coupled with the prospect of sitting in front of the class, to take care of pussy, and keep it quiet during the lesson.

After introducing the animal, proceed to examine it, point by point, in some such way as this:—

I. The Body

1. **Its Build.**—*Stand the cat on the table while the body is examined. Call attention to the build of it. Elicit as much as possible from the children themselves, step by step.*

The body is **long** and **slender,** but **deep.** It is not raised very high above the ground, as **the legs are rather short.**

Tell that it is **very lithe** *and* **supple in its movements.** *It can easily twist and turn in any direction. Perhaps some of the children may have seen the cat on a shelf, or on the kitchen dresser. Unless we frighten her, she rarely or ever breaks anything there, although she has to thread her way through crockery-ware and glass.*

2. **Its Covering.**—*Turn next to her coat, and, as before, let the children describe it.*

It is a **thick, soft, glossy fur** (black, white, or tabby, etc.). The cat takes great care of her beautiful coat.

She never lets it get dirty or matted together. She often washes it, although she never goes near the water, for **cats do not like water on their fur.**

How does she wash it? She washes it **with her tongue and paws.**

A lady likes to have a jacket made of thick, soft fur.

When does she wear her fur jacket? In the **cold weather** and **on cold nights.**

Why? Because **it keeps her warm.**

Then what sort of coat does pussy's fur make? A **nice warm coat.**

Stroke the cat. Tell that she seems pleased when we stroke her fur the right way, but worried **if we stroke it the wrong way.**

Ask the children to take notice next time they see a cat and a strange dog meet. They will see that her **back is arched**

up, *and* **her fur** *no longer smooth,* **but ruffled** *and* **standing on end.**

It always does this when she is frightened, and it shows how much she is afraid of the dog.

Take up a fold of the cat's skin in the hand, and point out that instead of being tight like ours, **it hangs loose about her body.** *Explain that this loose skin is a great help to the cat in her movements.*

3. **The Tail.**—*Notice next the long, slender tail.*

Puss is sitting quietly now, **with her tail curled up** round her feet.

When she walks about she usually **trails it behind her.**

Did you ever notice her tail when she comes to meet you in the morning? Yes; she then **carries it almost upright and stiff.**

Tell that this is her way of showing that she is pleased. She rubs her soft fur coat up against us, and begins to purr or sing. She means to say "Good morning; I am so glad to see you."

Did you ever see her **lash her tail** from side to side? Yes; she always does that **when she is frightened** or **angry.**

The tail, as well as the fur, tells us **whether the cat is pleased or angry.**

II. The Head

Call upon the children to examine and describe the head next.

It is **round in shape,** and **small** compared with the body. It has a **short, shrub nose,** but the **mouth** is very **large and wide,** as we may see when the cat yawns.

1. **The Tongue.**—Puss has been very good. She shall have this saucer of milk now.

Watch how she drinks it. She does not drink as we do; she **laps it with her tongue.** The **tongue is long and fleshy**; just fitted for lapping up liquids.

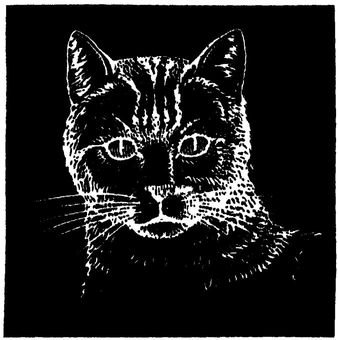
2. **The Ears.**—While she is finishing her milk, let us turn our attention to her ears.

Notice that these are **erect, wide open,** *and* **pointed**; *and that she can turn them quickly in any direction. Call her and notice how she* **pricks up her ears.**

Cats are **very quick at hearing.**

3. **The Eyes.**—*Bring a child to the front, and call attention to the round, black spot in the centre of his eye.*

That black spot is the **pupil of the eye.** Light enters the eye through the pupil and not through any other part of it.



The **coloured part** of our eye all round the pupil is really **a sort of curtain, to shut out some of the light,** when it is too bright.

Lead the children to tell that, when the sun is shining very brightly into our windows, **we pull down the blinds,** *to shut out some of the light.*

We could not see if the light was too bright; **it would dazzle our eyes.**

Now look at pussy's eyes. The **pupil** of her eye is **not round** like ours. It is **a long, narrow slit.** The light now is too bright for her, and so **the curtain closes up,** and **leaves only this very narrow slit.**

As evening comes on, this slit opens wider and wider—**the curtain is drawn aside**—to let in as much light

as possible. At night the curtain is drawn back **to the very edge of her eye,** so that the eye is **a great round window,** ready to take in all the light there is.

Perhaps some child may have come across the cat in a dark cellar, or in some other dark place. Ask him to tell what her eyes look like then.

They look like **round, blazing balls of fire** then. The cat can see well where we should be groping about in the dark.

4. **The Whiskers.**—*Call attention to the* **bare patch** *on each side of the mouth, with* **the long, stiff hairs** *or* **whiskers** *standing out from them.*

Tell the purpose of these.

The ends of these hairs **act as feelers,** and are a great help to the cat in the dark. With them she is able **to feel her way along,** when it is too dark even for her to see.

Show that these stiff hairs **stand out a long way** *on either side.*

The head is very small compared with the body; but she knows that if she can put her head into any place without touching her feelers, there is room for her whole body.

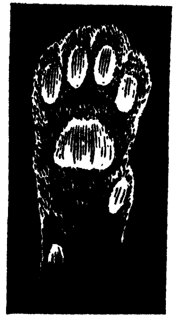
III. Legs and Feet

1. **The Legs.**—*Point out that the legs although* **slender** *are* **very strong**—*the hind-legs are more strongly built than the fore-legs.*

The cat's legs are specially **fitted for leaping** and **springing**. She is also a **splendid climber.**

Picture her climbing up the trunk of a tree. She is as much at home there as she is on the ground. She jumps down from a high wall, but she **never shakes or hurts herself,** *because her* **bones are very loosely jointed.**

2. **The Feet.**—*Pass on next to examine the cat's feet. Point out that the* **front paws have five toes,** *the* **hind ones four.**



Call attention to the **soft, smooth pads** *on the bottom of the toes. Count them. There are* **seven of these pads** *on the* **front paws,** *and* **five** *on the* **hind ones.**

The cat **walks on her toes,** not on the sole of her foot as we do. She is a **toe-walker.** As she walks on these padded toes, **she never makes a sound.** She moves about with a **gliding, stealthy, noiseless step,** wherever she goes.

Did you ever notice her paws when she was angry? Yes; she darts out her **sharp claws** then. If we tease her and make her angry, she will scratch us with them. Each toe is armed with a **strong, curved, pointed claw.**

Where are her claws now?

Tell that she is able to **draw them up** *or* **thrust them out** *when she pleases; that they are now drawn back, and* **covered up in a sort of sheath.** *She is not angry now.*

Explain that these sharp claws are very useful to the cat **in climbing trees.**

She keeps them drawn back in their sheaths as she walks about, so they **do not get blunt by rubbing against the hard ground.**

Who has seen the cat scratching against a tree, a fence, or even against the legs of the furniture?

Do you know what she is doing? **She is sharpening her claws.**

Summary of the Lesson

1. The cat's body is very lithe and supple in its movements.
2. It has a warm coat of fur, and a very loose skin.
3. The cat shows whether it is angry or pleased by means of its tail.
4. The cat laps its drink with its tongue.
5. Its ears are very sharp, and its eyes are made to see well, when it is too dark for most other animals to see at all.
6. The feelers serve instead of eyes when it is very dark.
7. The feet are padded, and the claws are protected by sheaths.
8. The cat is a good climber.

Lesson XV

THE CAT AND HER BIG COUSINS

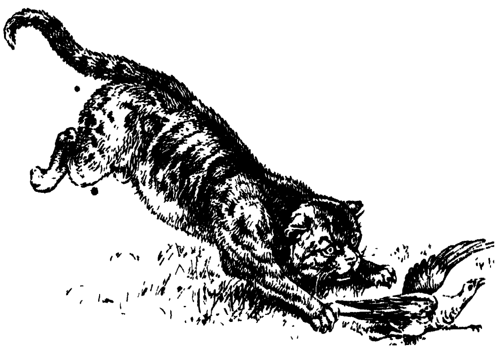
Provide for illustration: the living cat and pictures of the last lesson, a piece of meat, some biscuits, some milk, and pictures of the tiger, lion, and any other of the fierce cats.

I. Introduction

We gave puss a saucer of milk the other day, and watched her drink it by lapping it up with her tongue. To-day she shall have something to eat, for I want you to know how she eats, as well as how she drinks.

You know we give her all sorts of scraps from the table. She will eat almost anything.

But what kind of food does she like best? She likes **the flesh of mice and birds** better than anything else.



Picture the cat watching patiently and still at a hole for a mouse, or stealing quietly along after a bird. She looks anything but a gentle, playful, children's pet just then.

Lead the children to tell of **the fierce, glaring eyes, the moving tail, the body drawn up ready to spring** *forward. The mouse comes out—there is a sudden rush. With sure aim she leaps, and catches it in her claws.*

Then show the gentle, purring pussy of half an hour ago **changed into a fierce monster, growling savagely,** *and taking pleasure in cruelly torturing the little creature she*

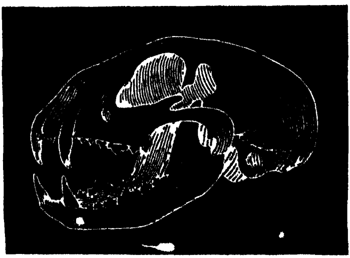
has caught, till at last **she tears it in pieces,** *and* **eats it up, flesh, bones,** *and* **all.**

All this seems very dreadful and very cruel, but the cat does it **because she was meant for it** and **made for it.** Let us see how this is.

II. The Cat's Teeth

Show these in the picture, or by means of a black-board sketch, or better still with the help of an actual skull if it can be obtained.

There are **six small sharp teeth** in front of each jaw. Beyond these on either side is **a long, powerful, pointed tooth,** which bends backward slightly; and beyond each of these again are **four large teeth with sharp points on the crowns.**



Give the cat a piece of meat now, and let her eat it while the children look on. Call attention to the way in which she presses it down with her fore paws, while with her head on one side **she tears it to pieces with those long, sharp, tearing teeth.**

The teeth behind these are not broad and flat on the top like ours; they have sharp, cutting edges, which **overlap like the edges of a pair of scissors.**

Explain that the cat **does not chew** *or grind up her food as we do. She cuts and* **chops it up** *with those sharp teeth, and* **swallows it in lumps.**

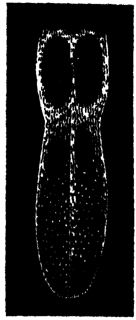
Set one of the children to eat a biscuit or a piece of bread, and notice the movement of his jaw.

The cat has no teeth for chewing. **The jaw has only one movement**—up and down; **it cannot move from**

side to side as our jaw does when we eat. Such teeth are fitted **for eating flesh.**

III. The Cat's Tongue

Get the cat to lap a little milk out of the hand of one of the children, and call upon him to tell what he observes.



The cat's tongue **feels rough**; it **scrapes his hand.**

Tell that the tongue really is rough. It is **covered with small, sharp, horny points,** *which stretch backwards.*

When the cat has a bone, she tears off as much of the flesh as she can with her teeth, and then she **scrapes the rest off clean by licking it with her rough tongue.**

Show, if possible, a bone which has been stripped clean by a cat.

IV. The Cat is formed to Kill.

The cat, then, was meant to live on the flesh of other animals. But she must catch the animals before she can eat them. Let me show you that she is made for this too.

Picture the mice—very sharp, very frightened.

What would they do if they could hear pussy's feet trampling on the floor?

But they do not hear her. Why? Because her **feet are padded** with soft pads. She creeps along on her padded toes **without making any noise.**

The instant the mice catch sight of her they run away, but although they are very sharp, she generally manages to catch them before they get to their holes.

Why? Because her body and legs are **made for leap-**

ing and springing. She darts forward with a sudden spring, and catches them.

How does she catch them? She **thrusts out her long, sharp claws** as she springs, and catches the mouse with them. **Those sharp claws were meant for this.**

Point out that perhaps puss may prefer a bird for dinner instead of a mouse, and birds live in the trees. Her sharp claws then **serve the double purpose** *of helping her to climb the trees as well as catch her prey.*

No other sort of feet would do for an animal like the cat.

V. A Night-Prowler

1. When do the mice come out of their holes? At night when all is quiet. The night, then, ought to be pussy's **best hunting time.**

Should you like to go about looking for something in the dark? No; we could not see in the dark.

This will be quite sufficient hint to lead the children to discover for themselves the connection between the eyes and the other special characteristics of the cat.

The cat is meant to be a night-prowler. She hunts her prey in the dark. **She requires eyes for seeing well in the dark,** or she would never be able to catch her prey.

2. *Remind the children that when she is waiting and watching for her prey, she often has to make her way* **through very narrow places,** *where it is too dark for even her sharp eyes to see. She must not make the least noise, or the mice will hear her. How does she manage then?*

Her whiskers act as feelers. She feels her way where she cannot see.

3. The mice live in their holes. They are quite safe there, for the cat cannot get near them.

How does she know they are there? She can hear

them squeak, and she waits patiently for them to come out.

Sharp ears, then, as well as **sharp eyes,** are **necessary for this night-prowling cat.**

4. *Lead the children next to tell that, if we are out late at night, we always take care to wrap ourselves up warm. It is much colder at night than it is in the day-time.*

The cat has a **thick, warm, fur coat,** because it was **meant to be a night-prowler.**

To sum up then. The animal's teeth show that it was meant to be **a flesh-eater.** It must hunt its food before it can eat it. Its body, legs, and feet make it **a hunting animal.** It hunts its prey at night. Its eyes, ears, whiskers, and covering fit it for **a night-prowler.**

VI. Other Cats

Picture to the class some cats that live wild in far-off lands. Lead them to imagine an animal **many times bigger than pussy,** *but with* **the same powerful eyes** *for seeing at night,* **the same padded feet,** *the* **same sharpened claws,** *the* **same terrible teeth;** *in fact, the* **same animal exactly,** *but many times larger and stronger.*

The fierce beasts always sleep in their dens all day long, and **at night come out to prowl through the forests in search of their prey.**

The **tiger** is most like the cat—indeed he is an immense cat.

Show a picture of the tiger in the jungle, and give a rough idea of his size. Call attention to his **beautifully striped coat.**

The **lion** *is another of these* **great cats.**

Show a picture, and call attention to the **thick, shaggy mane,** *which we do not see in the tiger.*

These fierce cats are so very strong that, **they prey upon animals as large as the horse and cow.** Sometimes they spring upon a man, and carry him off in their strong jaws.

Pictures of other members of the family, e.g. *the leopard, panther, and jaguar, might be shown, and if time allowed some little story of adventure might close the lesson.*

Summary of the Lesson

1. The cat is a killing animal ; it is formed to kill.
2. The teeth act like the edges of a pair of scissors.
3. The jaw has only an up-and-down movement.
4. The tongue is rough. The cat scrapes the flesh off a bone by licking it with this rough tongue.
5. The cat is formed for night prowling.
6. Lions and tigers are immense cats.

Lesson XVI

THE DOG

The teacher will require a good picture of the dog, and details of the structure as described in the lesson.

I. Introduction

Introduce by calling upon the children to tell all they can of the dog, its nature and habits.

It is one of the most sensible animals, and is so gentle and obedient that it can easily be taught. No animal is more loving and faithful to its master than the dog.

Compare the dog and the cat in disposition.

The cat seems to learn to love the house rather than

the people in it; but the dog cares little what the place may be, so long as he can be near his master.

How does the dog behave though when he meets a strange cat?

II. The Build of the Dog

1. **The Body.**—*Call attention to the picture, and point out that the dog is* **longer, broader, deeper-chested,** *and generally speaking* **more strongly built** *than the cat.*

Lead the children to think of their own chests, and the lungs inside them for breathing.

What happens when we run very fast? We **breathe quickly.**

Why? Because we want more air; **we get out of breath.**

Which would make the best runner, a boy with a big chest, or a boy with a small, narrow one? The boy with **a big chest.**

Why? Because the big chest **would take in more air** than the small one.

Now think of the dog with his broad, deep chest. Would you expect him to be a good runner? Yes.

What else must a runner have besides a big chest? **Long, powerful legs.**

Let us examine the dog's legs then, and see whether they are made for running.

2. **The Legs.**—*Point out that the legs are* **slender** *in build, but* **very strong.** *They are* **made for running.** *The legs as well as the chest of the dog prove that he was meant to be a running animal.* **The dog is one of the swiftest of runners.**

3. **The Covering.**—*Show that the* **dog's skin,** *like the skin of the cat,* **hangs loose** *about the body. It is covered with*

hair, not fur. *Some dogs have* **long, shaggy hair,** *others have* **a close, short coat.**

Elicit that cats never go near the water, even to wash themselves; they dislike water on their fur; but **dogs seem to love the water,** *and most dogs are* **splendid swimmers.**

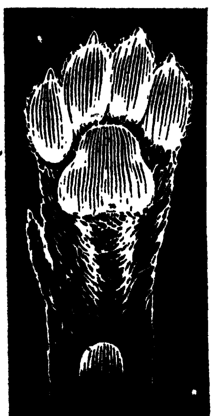
They soon **shake themselves dry** *when they come out of the water, but if the cat's fur gets wet,* **it clings about the body,** *and makes her uneasy.*

4. **The Tail.**—*Lead the children to compare the dog and the cat with respect to the use they make of their tails.*

Both use their tails **to show whether they are pleased or angry.** *The dog* **wags** *his tail* **when he is pleased,** *and* **drops it** *between his legs* **when he is in disgrace.**

He usually **trails it** after him, **as he walks,** but **it stands out stiff when he runs** very fast.

5. **The Feet.**—Like the cat, he has **five toes** on the



fore feet, and **four** on the **hind ones.** The toes too are

padded; for the dog, like the cat, **walks on his toes.** Each toe has **a strong, slightly curved claw.**

Now I want you to think for a moment about the cat's feet. When pussy lies quietly on the rug in front of the fire, where are her claws? She has them **drawn back in a sort of sheath.**

Are they always in the sheath? No; she **sends them out when she is angry.**

What does she do with them when she is walking? She keeps them **drawn up.**

The dog **cannot draw his claws back** in this way, even when he walks. Although his feet are padded, the ends of the claws rub the ground at every step.

The dog, then, **has not the quiet, noiseless step of the cat,** and his claws, from constantly rubbing on the ground, **are always blunt,** and **not sharp like those of the cat.**

Lead the children to think about the dog's habit of burying bones.

He makes a hole in the ground, and hides away the bones till he wants them. It is with these strong claws that he **scratches and digs.** They seem to be made for this purpose more than for seizing and holding.

6. **The Head.**—The dog has a larger and more pointed head than the cat. The lower jaw is very strong and has **only one movement,** up and down.

Show a picture of the dog's skull and teeth.

The teeth are sharp and pointed. They are **exactly like the teeth of the cat.** They are made for cutting through flesh, not for chewing or grinding.

The dog is a flesh-eater. Like the cat **he does not chew his food.** He simply cuts or chops it up with his sharp teeth, by means of the **up-and-down movement of the jaw.**

Picture a dog seizing a rat or some other animal. The cat seizes its prey **with its sharp claws,** *but the dog's claws are blunt; they are not fitted for seizing. He snaps at the rat*

with his open mouth, and catches it and holds it fast **with his four long, sharp-pointed teeth.**

7. **The Tongue.**—The tongue is not at all like the cat's tongue. Tell me how we describe the cat's tongue. It is dry and rough, **covered with sharp, horny points.**

The dog's tongue is **soft, smooth, and wet.** He does not use it as the cat does. He runs (particularly when it is hot weather) with his tongue hanging out of his mouth. If you watch you will see **water dropping from it.** I wonder what that means.

What happens to you when you run? You get very hot, and covered with little drops of moisture, which we call sweat or perspiration.

The dog's body never sweats or perspires, but when he gets hot, **all the moisture comes out through his tongue,** and as this moisture dries up, the dog's body gets cool.

You will know now why, on a hot summer day, you often see a dog lying down **with his tongue lolling** out of his mouth.

Lead the children to tell how the cat and the dog drink. Both animals are alike in this. They do not drink as most animals do. **They lap up the water with the tongue.**

8. **The Eyes.**—The dog is **not a night-prowler.** His eyes are not made for seeing at night. They are **not shaded by a curtain** in daylight. For the same reason he **has no need of feelers** for feeling his way in the dark; hence his whiskers instead of standing out like long, stiff, coarse bristles, are **short, fine hairs.**

Summary of the Lesson

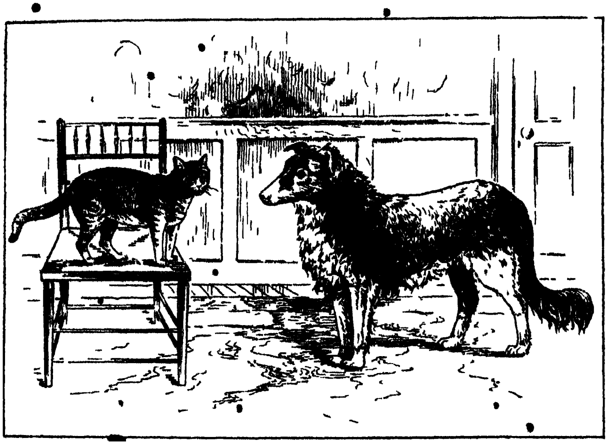
1. The dog is a running animal; it is made for running.
2. The dog shows whether it is pleased or angry by means of its tail.

3. The dog's feet are padded; but the claws cannot be drawn back. They have no sheath.

4. The dog seizes its prey with its teeth.

5. The dog laps water with its tongue.

6. The dog is not a night-prowler. There is no curtain to shade its eyes.



Lesson XVII

RECAPITULATION—THE CAT AND DOG COMPARED

It will be interesting and instructive to devote the time of a lesson now entirely to a recapitulation of what has already been taught about these two animals.

Deal first with the build, and then with the habits and character of each, leading the children themselves to tell that the difference in nature is dependent on the difference in build. As point by point is made, let it be set out in a few words on the blackboard.

I. Build

	Cat	Dog
1. Eyes.	Curtain to change size of pupil. Sees well at night.	No curtain. Does not see well at night.
2. Whiskers	Long, stiff feelers, to feel the way in the dark.	Short, fine hairs — useless as feelers.
3. Covering	Thick, soft, smooth fur.	Coarse hair.
4. Body .	Long and slender, for easy, gliding movement.	Long, broad, deep-chested, for running.
5. Legs . .	Short—made for creeping slyly about.	Long and powerful—made for running.
6. Feet . .	Paws with soft pads, sharp claws in sheaths. Walks without a sound.	Padded paws, blunt claws, which cannot be drawn back — no sheaths. Claws touch ground in walking.
7. Head .	Small and rounded in shape. Sharp, erect ears.	Large and long. Keen sense of smell.
8. Teeth .	Made for tearing and cutting—not for chewing. Jaw moves in one direction only—up and down.	Tearing and cutting. Powerful jaws for crunching bones—move up and down only.
9. Tongue .	Rough and dry — sharp, horny points for stripping flesh from bones. Drinks by lapping.	Soft, smooth, and wet. Lolls out of mouth. Perspires through the tongue. Drinks by lapping.
10. Tail . .	Lashes it in anger. Waves it to and fro when watching its prey.	Wags it when pleased. Carries it out stiff when chasing prey.

II. Character and Habits

Proceed next to show that as the two animals differ in structure, so as a natural consequence they also differ in their life, habits, and nature.

Picture the cat at night, **creeping about stealthily** *with noiseless step, and* **watching patiently at a hole** *for a mouse. She is formed for this; but it makes her* **sly and cunning** *in catching her prey, and when she has caught it, she takes a delight* **in cruelly torturing it** *before she kills it.*

Tell how differently the dog acts under like circumstances. Show him a rat hole, and instead of sitting down quietly and patiently for the rat to come out, he at once begins to **tear wildly at the hole with his strong, blunt claws,** *barking furiously all the while, till he finds his prey. But then* **he gives one bite** *with his strong jaws, throws the rat over quite dead, and leaves it.* **He never thinks of torturing it, and playing with it** *before he kills it, as the cat does.*

Lesson XVIII

KINDS OF DOGS

Provide pictures of all the dogs named in the lesson, and others of the wolf and fox.

Call upon the children to name the different kinds of dogs they have seen, and so lead up to some such classification as follows:—

I. The Hounds

Show, if possible, good pictures of each of these, as the lesson proceeds. These dogs are all used in sporting. They are all

swift runners, *and most of them have a very* **keen sense of smell.**

1. **The Grey-hound.**—*Notice the long, slender body and legs; the long, pointed head and muzzle.*

Such an animal is built for speed. The long legs and body tell us that it can run very fast.

But look at the picture again, and tell me whether you think this dog could run a long way. What do you think? Yes; it could run a very long way without getting out of breath.

How do you know that? Because it has a **large, deep chest.**

Tell that this dog has **wonderful running powers.** *It chases its prey* **by sight.** *Explain the meaning of this, and then proceed to show that such a dog* **does not require the keen scent** *which some dogs have.*

It **runs its victim down,** keeping it in sight all the time.

The grey-hound is used for hunting the hare (a very swift animal).

2. **The Stag-hound.**—This is one of the largest and strongest of the family. Instead of the fine, smooth coat of the grey-hound, it has a **rough, shaggy covering.**

It is kept for hunting the stag.

The Scotch Deer-hound is one of the largest and strongest of the family. It stands between two and three feet high at the shoulders.

Amongst the other hounds are the **Fox-hound,** used for hunting the fox; and the **Blood-hound,** a very large animal, **with powerful sense of smell,** used often for tracking men.

II. The Spaniels

Note the characteristics of these dogs. They are clothed with long hair, mostly curly or wavy. The ears are large and pendent.

1. **The Saint Bernard** is the grandest of these dogs.

Show a picture. Describe the power of this dog in finding people who have been lost and buried in the snow.

2. **The Newfoundland Dog** is another very large and powerful spaniel. This dog is a fine **swimmer,** and is very fond of the water.

Tell some stories showing the usefulness of the Newfoundland dog in saving people from drowning.

The pretty little **King Charles' Spaniel** is another member of the family; and so are **the Setter** and **the Pointer,** dogs used by sportsmen.

III. Bull-Dogs

Show a picture of one. Note the massive build of body, head, and legs.

The Mastiff is the noblest and most powerful of these dogs. Among the rest are the common **Bull-dog** and the **Bull-terrier.**

They are all very clever, sensible dogs, and are mostly kept as watch-dogs.

IV. The Sheep-Dog

Show a picture. Call attention to the **rough, shaggy coat,** *the* **sharp, pointed muzzle,** *and the* **small, erect ears.**

They are the most sensible and faithful of all the dogs.

Tell some stories to illustrate the character of these dogs.

V. The Dog's Wild Cousins

Show a picture of the wolf. Tell its name, and point out its close relationship to the dog. It is, in fact, a **great, shaggy dog,** *very fierce and savage.*

Wolves live and hunt together in great numbers or **packs.** They hunt their victim by chasing it and **running it down,** not by stealthily creeping up to it and springing upon it unawares as a cat does.

They have a **very sharp sense of smell,** and can scent their prey a long way off. They run with their heads close to the ground, and will **follow the scent for miles.**

Their hearing is very sharp, and their eyes are large and strong; but like the rest of the dogs they have **no curtain** for shielding the eye in the daylight, for **they are not night-prowlers.**

Wolves are very terrible creatures when they are hungry, and in the countries where they are found they not only attack sheep and oxen in the fields, but will chase travellers for miles.

Tell some little story illustrating this if time permit.

The fox is another of the dog's wild cousins.

Show a picture.

Call attention to its beautiful tail, which is called its **brush.**

Foxes live in pairs in holes which they dig in the ground. They are very **cunning** and even **clever.** They carry off the farmer's ducks, geese, and hens from the farmyard.

They are hunted **with fox-hounds** and men on horseback.

The **jackal, hyæna,** and **wild-dog** are other relations of our clever, sensible, faithful, tame dog.

Summary of the Lesson

1. Hounds are hunting dogs. Some of them hunt by sight; others by scent.

2. The Saint Bernard and the Newfoundland are the largest and noblest of the spaniels.

3. The mastiff, bull-dog, and sheep-dog are very sensible and very useful.

4. The wolf and the fox, the jackal and the hyæna are wild savage dogs.

Lesson XIX

THE SHEEP

Provide pictures of the sheep and ram, and a diagram or sketch of the four stomachs of the ruminants. An actual sheep's skull would be found most useful. It may be easily prepared by boiling the flesh away from a sheep's head, after which the bones may be cleaned and polished. Of course some care is necessary in choosing a perfect specimen at the shop.

I. Introduction

Show the picture, and proceed to elicit all the children can tell of the animal from their own previous knowledge and observation.

Most of them have seen sheep in the fields. The farmer keeps hundreds of sheep. They are **tame** *or* **domestic** *animals, but* **they do not live** *in and about the* **house,** *as cats and dogs do. They* **live together in flocks** *in the fields.*

They are **silly, frightened animals**; *they begin to* **bleat** *and run away, as soon as we go near them.*

All children have seen sheep driven along the road to the butcher's shop.

They are going to be killed. Why? Because **we want their flesh** for food.

We call it **mutton.** We can always see dead sheep hanging up in the butchers' shops.

Lead them next to talk about the **sheep's thick coat.** *We call it* **wool.** *Tell briefly the uses to which it is put in making* **warm clothing for ourselves.**

Tell too that the **skin** *of the animal is made into* **leather** *for many useful purposes. Show a piece of* **wash-leather.** *This was made from the* **skin of the sheep.**

Every part of the sheep is turned to good account. It is one of the most useful of animals.

Now that you have told me all you can, we will turn to the picture, and see what else we can learn about this useful animal.

II. Build of the Sheep

1. **The Body.**—The sheep is as big as **a very large dog,** but its body is **round** and **plump.** It is covered with **a thick coat of wool.**

Hand some wool round the class for the children to examine. Compare it first with the **soft, smooth fur of the cat,** *and then with the* **hairy coat of the dog.**

Tell that the sheep **lives in the open fields,** *night and day, all through the year, and so show the necessity for this thick coat.* **We call it a fleece.** *It grows very thick indeed as winter comes on. It is* **the sheep's winter overcoat** *to keep it warm.*

Explain that if it were left to itself the wool would get loose, and **begin to fall off,** *as the hot weather returns; for the sheep does not want its thick overcoat then.*

Instead of leaving it to fall off, **the farmer cuts it off** every year, at the beginning of summer, because it is very useful to us.

A new coat begins to grow as soon as the old one is cut off, so that the sheep is sure of a thick, warm covering again, before the winter comes back.

It does the sheep good to get rid of that thick coat all the summer.

2. **The Head** is **small** compared with the body. It is **broad at the forehead,** but rather **pointed towards the nose.**

The ears are **small** but very **sharp**; they can be raised **erect** at the slightest sound.

The eyes are **large, timid,** and **sleepy-looking**;

they are placed **at the sides of the face,** not in front as ours are.

The nostrils are **long, narrow slits,** but they can be **opened wide in a moment.**

Remind the children that even our tame, domestic sheep are **timid, frightened creatures,** *ready to run away if only a little child goes near them, although they have really nothing to fear in the fields where they live.*

Picture them in their **natural** *or* **wild state,** *where they are surrounded by* **fierce, flesh-eating animals** *that prey upon them. They must be always on the look-out for these terrible enemies.*

Sharp ears, eyes that can **see well all round them,** and a **keen sense of smell** are all necessary to give them timely warning against these enemies; for as they are not fighting animals, they have only their legs to depend upon for safety.

Show the picture of the **ram.** *Tell that this is the* **male sheep.** *Call attention to his* **large, twisted horns.** *The rams of the flock will fight for their* **ewes** *and* **lambs,** *by butting at the enemy with these strong horns.*

Explain that in some countries the ewes have horns as well

as the rams, but their horns are never so large and strong as those of the male sheep

3 **The Feet**—*Call attention to the* **feet** *of the sheep in the picture.*

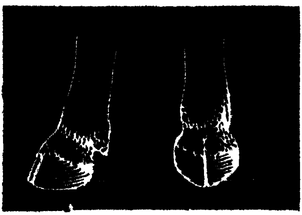
Lead the children to tell that **these feet are not paws** *like those of the cat and dog*

Show an actual sheep's foot if possible

Call attention to the two parts into which the foot is divided by **the deep cleft down the middle.** *These are really* **two toes.**

Notice how the flat inner surfaces fit closely together, as though the foot had been **split into two down the middle.**

We call this **a cloven foot. Cloven** means **split in two.**



Now call attention to the **hard, horny covering of the toes.**

We call a foot protected in this way a **hoof.**

The sheep's foot is a **cloven hoof.**

Show the **two little toes behind.** *The sheep* **walks on its two front toes only,** *so that these little toes behind never touch the ground All four feet are exactly the same in form and use*

III The Sheep's Food

The Teeth.—We have already learned that when we want to find out what sort of food an animal eats, **we must examine its teeth.**

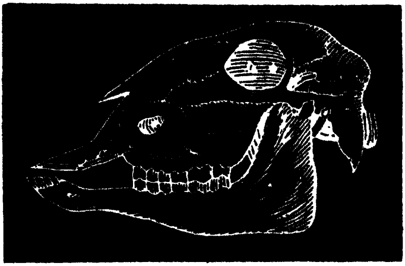
Suppose we were to offer the sheep a piece of raw meat (such as we give to the cat and the dog), would it eat the meat? No

It would not eat the meat, because its teeth are not made to cut flesh, but to **grind and chew.**

Show the sheep's skull, and call attention to the **broad, flat-topped teeth** *in both jaws.*

Teeth of this kind we call **grinders.**

Point out that grinders would be of no use if the lower jaw



moved in one direction only—**up and down**—*as the jaws of the cat and the dog do.*

The sheep is able to move its jaw not only **up and down, but from side to side—in all directions.** The food is crushed and ground up as in a kind of mill by these teeth.

Proceed now to notice the rest of the teeth. The children will be sure to miss the four long, sharp, seizing teeth, which they have become familiar with in the cat and the dog. The sheep is **not meant for seizing and tearing prey.**

Point out the row of sharp, cutting teeth in front of the lower jaw, and lead the children themselves to discover that there are **no teeth at all in the upper jaw** *opposite these.*

Show the **hard, thick, leather-like pad** *which takes the place of teeth in front of this jaw.*

The sheep **feeds mostly on grass.** As it feeds it collects up a mouthful of grass **with its long, fleshy tongue and lips,** and the teeth in the lower jaw then **hold it firmly against the hard pad.** Then with a sharp jerk of the head, the little bundle of grass is partly torn and partly cut off

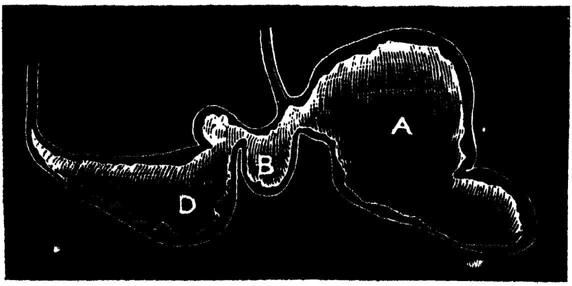
IV. How the Sheep feeds

Picture some sheep feeding in a meadow.

If we watch them carefully one by one, we shall see that they tear off the grass, mouthful by mouthful, and **swallow it at once,** as they walk along.

What do we do with a mouthful of bread and butter before we swallow it? We **chew it well** first, and then we swallow it.

Explain that sheep do not eat like this. They go on collecting and swallowing the grass bit by bit, until they have got as



much as they want, but **they never wait to chew their food** *before swallowing it.*

Lead the children to tell that they have sometimes seen sheep lying down quietly on the grass, and moving their jaws as if they were chewing something.

Explain that **they are really chewing** *then.*

They **swallow the grass** first of all **without chewing,** and it passes down into a large bag, A, which we call the **paunch,** or **first stomach,** and they go on swallowing in this way until the paunch is full of food.

Then they leave off eating and lie down on the grass, as you have seen them.

While they are lying at rest, the grass is passed **from**

the paunch into another and smaller bag, **the second stomach,** B. In this bag it is rolled up into **little round balls** or **cuds,** and these are brought up into the mouth again, one by one, **for the purpose of being properly chewed.**

This is really what the sheep is doing as it lies so quietly on the ground. The **broad, flat, grinding teeth** act like the millstones of a mill; they **crush** and **bruise up the grass.**

After being well chewed the grass is again swallowed, but it goes into another bag now—**the third stomach,** C; and from this it passes into another—**the fourth** or **true stomach,** D.

This way of eating we call "**chewing the cud.**"

Other animals chew the cud besides the sheep. Among them are the cow, the deer, and the goat, as well as the camel, the giraffe, and many strange animals that live in far distant lands.

Summary of the Lesson

1. The sheep's fleece of wool fits it to live in the open air in all weathers.
2. Sheep are timid animals. They have large ears, and their eyes are placed at the sides of the head—not in front.
3. The sheep has a cloven hoof. It walks on two toes.
4. The sheep has a pad in front of the upper jaw instead of teeth; and strong grinders behind.
5. The sheep chews the cud; it has four stomachs.

Lesson XX

THE PIG

A picture of the pig will be required; and an actual skull, if it can be prepared, will serve much better than a picture for illustrating the animal's teeth, etc.

I. Introduction

1. *Show the picture, and ask the children for the name of the animal. Tell its other name*—**hog**—*and explain too that the mother pig is called* **a sow,** *the male pig* **a boar.**

The farmer rears pigs on the farm, and most people in the country keep a pig. They give it a little house to live in, which we call a **sty.** What name do we give to all the animals which we rear and keep about our homes in this way? **Tame** or **domestic animals.**

Some of the children may have seen a **pig-sty.** *If so, let them describe it. It is often* **a very filthy place.** *But point out that this is* **the fault of the people,** *not of the pig. The pig is not naturally more filthy in its habits than any other animal, and has quite as much need to be kept clean.*

2. The pig, then, is another of our domestic animals, and a very useful animal it is.

Can you tell me in what way it is useful? Its flesh gives us food.

What do we call the flesh of the pig? **Pork.**

Now think again. Is the flesh of the pig always called pork? No; some of it is **bacon.**

What is the difference between **pork** and bacon? Pork is the name for the **fresh-killed meat** which we see in the butcher's shop. Bacon is the same meat **salted and dried.**

What is the object of turning the fresh pork into dried meat?

Lead the children to tell that the fresh meat in the butcher's shop would not keep very long; it would soon go bad, and become unfit for food.

Tell that **the salting preserves the meat,** *and explain briefly how it is done.*

The pig, as soon as it is killed, is cut into two halves, down the middle of the back, and these are laid **in strong brine,** till they are well salted. They are then taken out

of the brine, and hung up **to dry in the smoke of wood fires.**

When the meat is quite dried, or **cured,** it is not at all like pork, either in look or taste. We call it **bacon,** and it will keep for a very long time.

We call the two halves of the animal **flitches** or **sides of bacon.** The legs are cut off, and salted and cured by themselves. These we call **hams.**

The pig, you see, is a very useful animal, but, unlike the sheep, it is useful to us only when it is dead. It supplies us with three kinds of meat—pork, bacon, and ham. Let us see now what we can learn about the animal itself.

II. How the Pig feeds

1. *Lead the children to tell of the* **greedy, gluttonous nature** *of the pig; always ready to eat up anything—not at all particular what it is.*

When any one is very greedy indeed, we often say he is **piggish** or **hoggish,** which means that he is as greedy as a pig.

Remind them that the sheep feeds on the grass in the meadows, and is quite content with that food. Tell that the pig, if allowed to run loose in a field, would eat the grass too, but it would also eat whatever else came in its way.

2. The pig is fond of **grubbing in the earth for roots.** If it finds its way into an orchard or a potato-field, it will live on **the fallen fruit** or **the potatoes** in the ground. It has a special liking for **acorns** and **beech-nuts** in the autumn, but nothing comes amiss to it when it is hungry.

It will even eat bits of meat, **like the cat and the dog.**

3. People who keep pigs always have a large tub, into which they throw all the waste from the table—**pieces of**

meat, bread, potatoes, vegetables, pot-washings, everything,—and it all goes.

Let us compare the pig with the **cat,** the **dog,** and the **sheep,** and see what we can find out about it, for we know now that animals live and feed in their own particular way, **because they are made and intended for it.**

III. Build of the Pig

1. The Head.—*Call attention to the* **long, pointed head,** *ending in* **a strong** *and* **rather broad snout.**

This snout is made of hard, tough gristle, and is intended for **grubbing in the ground.** The nostrils are at the end of the snout, and the **sense of smell is very keen.**

Picture the hog in its wild state roaming through the woods and forests in search of food. It finds, by means of its **keen smell,** *roots and other things, although they are beneath the ground, and then* **with its strong snout** *it grubs them up. This strong snout, then, is very useful to the animal, and fits it to live on the food it likes best.*

Lead the children to imagine a pig with a head like that of the cat, the dog, or the sheep, and show that in either case it must starve, or learn to eat different food.

The wide, rounded mouth of the cat, formed to seize

and tear its prey, **could not grub up roots** out of the earth.

The long, sharp nose of the dog, and the soft, movable lips of the sheep are each fitted for the work they have to do, but **that work is not rooting and grubbing** in the ground.

The Mouth.—*Notice the great mouth with its large, powerful teeth in both jaws. Besides great* **grinding teeth** *at the back, like those of the sheep, it has a row of front teeth* **in both jaws,** *and* **four large, sharp-pointed teeth,** *like those of the flesh-eaters, one on each side of the head and in the upper and lower jaws.*

In the boar, that is the male animal, these four pointed teeth grow into **great curved tusks,** which stand out from the sides of his mouth.

The wild boar is one of the most terrible animals of the forest, because of his great, sharp tusks, which he can use with dreadful effect against his enemies.

The pig, then, lives upon flesh as well as vegetable food, because it has teeth **for tearing flesh,** as well as others **for chewing and grinding.**

3. **Sight and Hearing.**—The eyes are **small** and **deeply set,** and the **ears** rather **large** and **upright.** The eyes of the common pig seem dull and sleepy, but in the wild state, where the animals have to be on the watch for their enemies, both **sight and hearing are very sharp.**

Compare the cat, dog, and sheep in this respect. The eyes of the flesh-eaters are keen and powerful, **to help them to catch their prey**; *those of the sheep, large, timid, and watchful*—**ready to take alarm at the least sign of danger.**

4. **The Body.**—The body is **round like a barrel,** the **neck** very **short,** and the head in a line with the back. It has a **short, thin tail,** which is usually **twisted into**

a curl. The skin is hard and thick, and covered with stiff hairs which we call **bristles.**

5. **The Legs and Feet.**—The legs are short, and the feet are **cloven** like those of the sheep. The foot has **four toes**: the two front ones are covered with a **horny, cloven hoof**; the hinder pair are smaller, and **do not touch the ground** in walking.

Now what did we learn about animals with cloven hoofs? They **chew the cud.**

Yes; most of them do, but the pig, although it has a cloven hoof like the sheep and the cow, **does not chew the cud.**

It has only **one stomach**—not four as they have—and **it chews its food before swallowing it.**

Picture the animal feeding. It would eat and eat as long as there was anything before it, and it would then most likely roll over and doze, with its little eyes almost shut. But we should not see its jaws moving in the act of chewing.

IV. Other Uses of the Pig

You told me how useful the pig's flesh is for food. Let me now tell you the uses we make of some other parts of the animal.

1. **The Skin.**—The skin is sometimes taken off, and can be tanned into a very useful kind of **leather for covering saddles** for horses.

Call attention to the thick skin, as it is usually seen in the crackling on the pork, or the **rind of the bacon.**

2. **The Bristles.**—These are very useful in many ways. We use only those which grow on the back, as they are thick and strong.

Lead the children to think of **brushes** *and* **brooms** *of various kinds. The long bristles are used for making* **sweeping-brooms**; *the short, stiff ones (sometimes black, sometimes*

white) are made into **hair-brushes, clothes-brushes, tooth-brushes.**

Who has seen a shoemaker sewing a shoe? What does he use instead of a needle? A **bristle.**

Explain why he uses a bristle, how he fastens it to his waxed thread, and how he works with it.

Summary of the Lesson

1. The pig does not chew the cud. It has only one stomach.
2. It has teeth in front of both jaws.
3. It has a strong snout for grubbing in the ground.
4. The pig, like the sheep, has a cloven hoof.
5. We eat its flesh; its skin is made into leather, and we use its bristles for making brushes.

LESSONS ON SIMPLE NATURAL PHENOMENA

Lesson I

THE SKY

The teacher should be provided with a round glass bowl.

I. Introduction

1. *To render this lesson effective, the teacher would do well to select a bright, clear day for it, so that the children may be able to approach it with their minds fresh from what they have seen. Commence by leading them to talk about their run to school. How bright and cheerful everything looked. When they raised their eyes above them, they saw everywhere the clear blue sky.*

To-day we are going to see what we can learn about this beautiful sky.

You saw the sky above you on your way to school: you can see it now through the window. But can other boys and girls, in other places, see the sky too? Can people a long way off see it? Yes; wherever we go, **we always have the sky over our heads.**

2. In one of our lessons we spoke of something which is all round us wherever we go. What is that? Air.

This room is full of air; but when I look across it I

can see things on the other side. I can see through the air, but I cannot see through this slate.

We say **the air is transparent,** because we can see through it. This slate and all other things which we cannot see through are said to be **opaque.**

Tell that **this transparent air** *is not only* **all round us** *wherever we go, but stretches high above our heads, and really* **forms the sky.**

We look up through the air around us, and see the blue sky overhead, but **this sky is only the air itself,** which spreads out and stretches upwards to a very great height.

II. Shape of the Sky

1. When you look up at the sky, what shape does it seem to be everywhere? **Curve-shape.**

Which part of the curve seems to be the highest? **The part over our heads.**

Where does the curve seem to end? It **seems to bend down** till it touches the earth on all sides.

Show a large bowl (a glass one for preference). Stand it upside down on the table, and lead the children to compare the shape of the sky to the shape of the bowl.

It looks like a very, very large bowl, placed upside down on the earth, just as this one is placed on the table. **It covers the earth** all over **like a great round roof.**

2. *Call attention to the rim of the bowl which touches the table all round.*

Lead the children to tell that when we get away from the houses, and can see a long way off, **the sky seems to touch the earth,** *just as the rim of this bowl touches the table.*

Tell that this line, **where the sky seems to meet and touch the earth** *all round, is called* **the horizon.**

III. Clouds in the Sky

1. What colour do you say the sky is to-day? Blue. Is it blue all over? I think I can see some parts of it, here and there, that are not blue. Look through the window, Harry, and tell me whether you can see any parts of the sky that are not blue.

Let the child describe to the rest of the class the **small white patches** *dotted over the sky here and there. They look like little heaps of* **loose white wool** *or* **feathers.** *Elicit that these are called* **clouds.** *Point out that sometimes, although not often, there is not one of these little white clouds to be seen; the sky is blue all over. We then call it a* **cloudless sky.**

2. *Lead the children to tell, on the other hand, that they sometimes see no blue sky at all. It is of a* **dull grey colour** *all over.*

Explain that this is because the sky is covered with thick clouds. We then call it a **cloudy sky.**

These thick clouds **hide the blue sky** from us, because they are opaque; we cannot see through them. As soon as the clouds roll away, we see the blue sky behind them.

3. *Point out that although the clouds sometimes shut out the sun, moon, and stars, they are very good to us. They send us* **the beautiful rain** *to make the things grow.*

Trees, grass, and flowers want rain as well as sun to make them grow. In the cold weather the clouds send us **snow and hail** instead of rain.

IV. What we see in the Sky

1. *Call upon the class now to say what else they have seen in the sky besides clouds, and proceed to elicit all they have to tell about the* **sun, moon,** *and* **stars,** *assisting, of course, where they fail.*

The Sun.—It shines in the daytime only. It looks **like a great round lamp** in the sky. When it is

shining **everything looks bright** and cheerful, but at night, when it is not shining, **all is darkness.**

What then does the sun do for us? It gives us **light.**

Tell that it is the light of the sun shining down upon us that gives the sky its beautiful blue colour. How dark and cheerless everything would be without the sun.

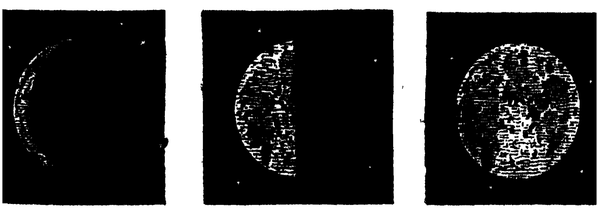
How do we feel when the sun shines upon us? We feel **warm.**

The sun then **gives us warmth as well as light.** It is **like a great round ball of fire** in the sky. Without the sun's warmth we ourselves, and all animals, would die. There would be no trees, or grass, or flowers; for they could not grow without the sun.

Sometimes the thick clouds shut out the sun, so that we cannot see it, or feel its warmth. The sky is then dull and cheerless; there is **no brightness or warmth** anywhere.

The Moon.—At night, when the sun is no longer shining, the moon comes out in the sky.

1. *Lead the children to tell that it does not look like the sun great ball of fire. It is* **white and silvery.** *We can*



look at the moon without blinking, but we **cannot look at the bright sun.**

2. *Endeavour to make them talk of the changing shape of the moon, and explain and illustrate on the black-board,* **new moon, half-moon,** *and* **full moon.** (*See* EDUCATION DEPARTMENT CIRCULAR.)

The Stars.—*Let them next talk of the stars, and when they are to be seen.*

1. How many stars are there? There are so many that **we could not count them.** They help the moon to give us light at night, when the sun is not shining on us. They are dotted **like tiny lamps** all over the sky. They shine and twinkle all night long. Sometimes **the clouds shut out the moon and stars,** and the night is then very dark.

2. *Compare the light of the stars with the brilliant light of the sun, and point out that* **all day long** *they are shining up there, just as we see them shine at night. We do not see them in the daytime,* **because their weak, pale light cannot shine through the bright light of the sun.** *But we know they are there in the daytime as well as in the night, because if we go down into a very deep, dark pit, and look up at the sky in broad daylight, we can see them there.*

Summary of the Lesson

1. The transparent air all round us reaches high above our heads and forms the sky.
2. The line where the sky seems to touch the earth is called the horizon.
3. Clouds float about in the sky. They send the rain.
4. The sun warms us and gives us light in the daytime.
5. The moon and stars give us light at night.

Lesson II

THE SUN

Provide for illustration: a large wire ring and movable ball, and a couple of spring clips to fasten the ring to the edge of the table.

I. Introduction

1. *Refer the children to their last lesson, and lead them to tell*

all they can of the sun, as regards its appearance in the sky, and what it does for us. It is like **a great round ball of fire** *in the sky; it gives us* **light** *and* **warmth.** *We feel the warmth of the sun when it shines on us.*

How long does the sun shine on us? It shines on us all day. **It begins to shine** in the morning, and **it goes away** in the evening.

How do you know it is the sun that gives us light? Because in the evening, when the sun is not shining, **it grows dark,** and the next morning **it gets light again,** as soon as the sun begins to shine.

2. Can we see the sun in the sky every day, and all day long? No; we sometimes cannot see the sun at all.

Why is that? Because sometimes there are thick clouds in the sky, and **they hide the sun from us.**

But are you sure the sun is always in the sky in the daytime—say, on a very cloudy day? Yes; because if the sun was not shining, **it would be as dark as it is in the night.**

Quite right. The sun is shining in the sky **if the day is ever so cloudy.** The thick clouds hide the sun from us; but **they cannot shut out all its light.** Some of the sun's light passes through the clouds, just as it would **through our window-blinds,** if we pulled them down.

II. What the Sun is Like

1. The sun, you say, is like **a great round ball of fire.** On a bright day we cannot look at the sun. It hurts our eyes, so that we cannot see well afterwards. We say that things **dazzle our eyes,** when they are so bright that we cannot look at them without making our eyes ache.

Can you tell me whether the sun is always the same colour? It is not always the same colour. All day long, if the sky is clear, **the sun is bright yellow,** like gold.

In the evening, just before it leaves us, **it is often red, like fire.**

2. *Remind the children of the beautiful red clouds, which are often seen in the sky in the evening. The clouds are sometimes so red, that they* **almost look as if they were on fire.**

What is it that makes the clouds look red at such times? It is **the sun shining through the clouds.**

Why is it that we sometimes do not see the sun in the daytime? The thick clouds hide it from us.

Then which must be nearer to us, the clouds or the sun? **The clouds are nearer than the sun.**

III. Sunrise, Noon, Sunset

1. We spoke about the window-blinds just now. When are we glad to pull them down? When the sun shines through the window into our eyes.

Do we pull them all down at the same time? No; sometimes one of the blinds is pulled down, sometimes another.

What do you learn from that? We learn that the sun **does not always shine through the same window.**

Ask the children to observe for themselves from day to day that in bright, sunny weather the same blind is always pulled down at the same time in the day.

The sun always shines through the same window at the same time every day, when it is not hidden by the clouds. (*See Education Department Circular.*)

2. *If the lesson is given in the open air, the teacher might so arrange the class as to make it necessary to move some of the children from one side to the other as the sun begins to shine into their faces. This, of course, would naturally lead to the same deduction that* **the sun is not always in the same part of the sky.**

Lead the children further to tell from their own observation that at a certain part of the day they always see **one side of the playground** (*or of some well-known street*) **in the**

sunshine; *later on it is* **the other side** *that is* **lighted up.**

3. We have learned then that the sun is not always in he same part of the sky. Look at the sky, and see if you can point out where the sun was when you went home at twelve o'clock.

Assist them in this, and explain that the sun is **always in that part of the sky at twelve o'clock** *in the day. Notice that it is not there now, and lead the children to tell that it is* **not so high** *in the sky now as it was at twelve o'clock.*

4. Who has watched the sun in the evening, just before it begins to get dark?

Is it high up in the sky then, or low down? It is **low down,** quite close to the earth, where the earth and sky seem to meet and touch.

What do we call that part of the sky? **The horizon.**

What becomes of the sun after that? It **sinks down below the horizon.**

What happens then? The light dies away little by little, and the **dark night comes on.**

When do we see the sun again? **Early the next morning.**

Is it high in the sky then, or low down as it was the evening before? It is **very low down.**

5. *Explain that it comes up little by little from below the horizon,* **just as we see it disappear in the evening.** *Picture it as it comes gradually into view. Sketch the rising orb on the black-board, in its different phases.*

Suppose some one sat all night and watched the spot where the sun went down. Would he see it come up next morning in the same place? No; we always find the sun **in another part of the sky** in the morning.

6. *Explain that, if the watcher wished to see the sun come up in the morning, he would have to turn his back to that part*

of the sky where it went down; for **it comes up on the opposite side of the earth.**

7. N.B.—*The teacher should take the opportunity at this stage of impressing upon the children, in as simple a way as possible, that these* **apparent movements of the sun** *are after all* **only an illusion,** *although too much must not be made of it now, as it is a difficult subject for young children to grasp, and will be dealt with to more advantage later on, when the rotundity of the earth has been taught.*

For the present it is best to meet them on their own level, and to be content with one step at a time.

Ask some child who has been in a railway train to describe what he saw when he looked out of the carriage window at the houses, trees, and tall poles by the side of the line.

Lead him to tell (1) *that these things* **seemed to be rushing past in the opposite direction** *to that in which he was going; and* (2) *that when he looked at them,* **he almost forgot that he was moving** *in the train, and* **they were standing quite still.**

8. *Tell that it is exactly the same with the sun.*

The sun seems to move across the sky in one direction, but in reality **it does not move at all**; it is **the earth** on which we live **that moves,** and it moves **in the opposite direction.**

Promise to tell them more of this another time.

IV. East and West

1. *Fix the wire ring in position now behind the table, and slowly and gradually move the ball up from below.*

This represents the sun, as it **seems to come up from below the horizon** in the morning. We say **the sun is rising.**

Move the ball along the ring, and show that as it moves it is getting **higher and higher.** *When it reaches the highest*

part of the ring, measure with a tape, and show that **it has made half its journey.**

The sun in the same way mounts **higher and higher in the sky till twelve o'clock in the day.** At twelve o'clock it is at its **highest point** in the sky, and we say it is **noon.**

That part of the day **before twelve o'clock** is called the **forenoon.** Why?

2. *Now move the ball slowly and gradually down the other half of the curve, pointing out that as it moves it is getting* **lower and lower down,** *and at last let it disappear altogether below the edge of the table.*

After twelve o'clock **the sun sinks gradually lower and lower,** and at last in the evening it passes away out of sight **below the horizon.** We say **the sun sets.** What do we call that part of the day after twelve o'clock? Why?

3. *It would be well to let the children see the ball pass along the lower part of the ring, and return to the horizon once more. This could be easily done by loosening the spring clips one by one.*

4. *As the ball comes up into view, tell that the part of the sky* **where the sun rises** *is called the east.* We say **the sun rises in the east.**

Now pass it slowly along the arch to the opposite end, and let it disappear once more.

What do we say the sun does when it sinks down like this? We say **the sun sets.**

Explain that the part of the sky where the sun sets is called the west. **The sun sets in the west.**

N.B.—*The teacher would do well (in preparation for the later lesson) to make this arch, and the imaginary journey of the sun along it, and more especially the position of the sun at noon, subjects for daily observation by the class. (See* EDUCATION DEPARTMENT CIRCULAR.)

The sun streaming in at a certain window—always the

same one—just as the class is being dismissed at twelve o'clock, or shining over some fixed object in the playground as they run off home, would thus become a familiar sight to all.

Summary of the Lesson

1. The sun is a great round ball of fire.
2. The clouds are nearer to us than the sun.
3. The sun rises in the east every morning, and sets in the west every evening.
4. The sun is at its highest point in the sky at noon.

Lesson III

SUNSHINE AND SHADOW

The teacher will require a small paraffin lamp, and a spike, or stick of some sort, capable of being set up erect on a flat disc for observation from time to time.

I. How Shadows are Formed

1. *Pull down the window-blinds, so as to shut out the daylight as far as possible, and then light the lamp. Notice that the lamp at once sheds its light in all directions, so that the room instead of being dark is now lighted up.*

Why is this? Because the air is transparent; **light can pass through it.**

Now stand one of the children in the middle of the room, and hold the lamp behind him. Call the attention of the class to the **dark patch on the floor,** *which begins at the child's feet, and* **stretches across the room in front of him.**

Point out that it is something like the boy in shape, only very much bigger.

2. What do we call this dark patch? We call it a **shadow.** It is **the shadow of the boy.**

Why does the lamp throw the boy's shadow on the floor? Because the boy's body is **opaque.** The **light**

cannot pass through it, as it does through the transparent air all round.

3. *Show that his body actually stops the light from passing to that part of the floor, and so* **a dark shadow remains there.** *Hold the lamp in front of the boy, and let the class observe that the shadow is now* **behind him.** *Hold it on one side, and* **show the shadow on the other,** *and so on.*

Let the boy walk across the room, and the class will see that **the shadow moves as he moves.**

4. *Lead them next to describe, from their own observation, the shadows cast by the firelight, and by the gas-lamps, and lighted shop windows in the streets.*

Hold up a variety of objects, and point out (1) *that* **they all cast shadows** *if they are opaque, and* (2) *that the shadow is in every case* **similar in shape to the object** *which casts it.*

5. *Call attention to the length of the boy's shadow on the floor, and while doing so gradually raise the lamp, and let him walk slowly towards it.*

What do you observe now? As the lamp is raised higher, **the shadow gets shorter and shorter.**

Notice what happens when I hold the lamp directly over his head.

Where is the shadow now? There is **no shadow at all now.**

Hence we see from this that, **when the lamp is low the shadows are long, when it is high the shadows are short.**

II. The Sun and its Shadows

1. We will put out the lamp, and draw up the blinds now, for we are going to talk once more about the **great lamp that shines in the sky**—the sun.

When the sun is very bright and hot where do we like to sit? In a **cool, shady place.**

Where do we find these cool shady places? Under a tree, or by the side of a wall **where the sun is not shining.**

Why is the sun not shining there as well as in other places? Because **the tree and the wall are opaque**; the sun cannot shine through them. It **casts a shadow of them** on the ground.

2. *Point out that it is cool as well as shady there,* **because the heat of the sun as well as its bright light is shut off.**

Tell that the sun (like our lamp) casts shadows of every opaque object on which it shines, and lead the children to tell that on a bright, sunny day, they always **see their own shadows on the ground** *as they walk along—sometimes in front of them, sometimes behind them, and sometimes at their side.* Sometimes the shadow is sharp and well defined, sometimes it is blurred. Why?

3. *Refer to the experiments with the lamp, and ask them to* **measure one another's shadows** *in the open air at different times in the day.*

Remind them that when the lamp was low the shadows were long, when the lamp was high the shadows were short; and explain that they will find it exactly so with the sun.

At what part of the day is the sun highest? **At noon.**

What sort of shadows would you expect to find then? **Short shadows.**

When would you expect the shadows to be long? Just before sunset.

Why? **Because the sun is then very low down in the sky.**

4. N.B.—*This lesson, like others of a similar nature, depends for its full development upon constant observation.*

It would be well to note by the aid of a spike set up erect on

a flat disc the varying length of the shadow at noon throughout the year.

For the present, and during the lesson, the teacher must of course be content with simple explanation, but he would have ample opportunity of verifying his statements by observation of the spike and its shadow from month to month. (*See* EDUCATION DEPARTMENT CIRCULAR.)

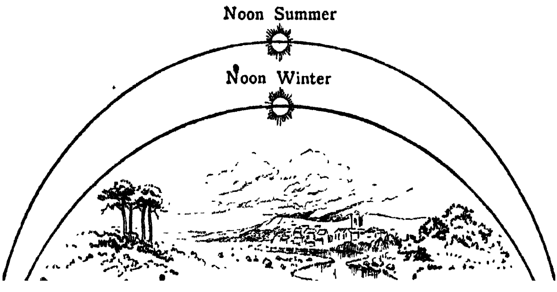
The noon shadow in the summer-time is **much shorter than it is in the winter.**

What does this tell us? It tells us that the sun at noon is **higher in the sky in the summer** than it is in the winter.

III. Short Shadows, Long Days

1. *Draw an arc on the black-board showing the position of the sun at noon, and also its position at sunrise and sunset.*

This curved line represents the great arch in the sky



along which the sun seems to travel from east to west.

We found just now that the sun is **not so high at noon in the winter** as it is in the summer. We will let this other curve represent the sun's winter journey. At noon, you see, the sun is still in the same part of the sky, **exactly in the middle of the arch,** but it is lower down than it is in the summer.

Let us measure these two curves from the middle of the arch both ways. The **upper curve is much longer** than the other.

What does that mean? The sun has farther to travel in the summer than in the winter.

2. *Be careful to impress upon the children that* **the sun must reach the top of the arch** *(the middle of the journey)* **at noon,** *or twelve o'clock, every day whether it be summer or winter.*

Then as it has farther to travel to get to the top of the arch in summer than in winter, what must it do? **It must start earlier.**

What do you mean by that? **It must rise earlier.**

Explain that the sun does actually rise earlier—much earlier—in the summer than in the winter. **It rises hours before we are out of our beds.**

Proceed to show next that after it reaches the top of the arch at noon, the other half of the journey remains to be done.

The part of the day **from noon to sunset** is as long as the other part **from sunrise to noon.** In the middle of summer the sun rises at about a quarter to four in the morning, and sets at about a quarter past eight in the evening, making a very long day of sixteen hours and a half. (*See* EDUCATION DEPARTMENT CIRCULAR.)

IV. LONG SHADOWS, SHORT DAYS

1. *Call attention to the other curve now. Remind the children that this represents the sun's winter journey, and that as before the sun must be exactly at the top of the arch at noon.*

Point out that as this winter journey is so much shorter than the summer one, it is not necessary to start so soon. **The sun rises much later in winter than in summer.**

Point out too that the second half of this journey from noon to sunset is as short as the first half.

The sun sets much earlier in winter than in summer.

2. *Tell that it is not easy for little boys and girls to see the sun rise or set in the summer, as it is up hours before they are out of their beds; and it does not set till long after their proper bed-time in the evening.*

But in the middle of winter (say on Christmas Day) every one may see both sunrise and sunset, provided it be a clear, bright day; for the sun does not rise then till about **eight o'clock in the morning,** *and it sets* **just before four o'clock in the afternoon,** making a very short day of less than eight hours.

As a matter for further observation in connection with this subject, the teacher would do well to note as far as possible the objects over which the sun is seen to rise and set from month to month. (See EDUCATION DEPARTMENT CIRCULAR.*)*

Summary of the Lesson

1. Opaque things cast shadows, because light cannot shine through them.
2. When the sun is low in the sky the shadows are long; when the sun is high the shadows are short.
3. The noon shadows in summer are shorter than they are in winter.
4. The sun rises earlier and sets later in the summer than in the winter, and it also mounts higher in the sky at noon.
5. That is why the days are longer and warmer in summer than in winter.

Lesson IV

CLOUDS

Provide the teacher with pictures showing the different kinds of clouds. A small kettle and tripod stand, and either the Bunsen burner or a spirit-lamp will also be required.

I. Introduction

This lesson, from its very nature, like others of its kind, would have more interest for the children if a suitable day were selected for it, because then they would have actually before their eyes all the phenomena with which it deals.

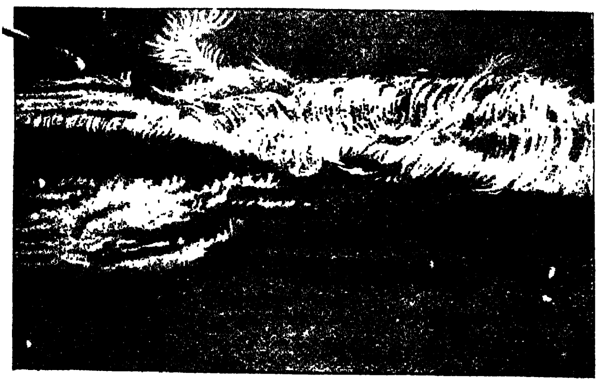
With the rain falling fast outside, then, the teacher would naturally commence by making some remark about the wet day.

Boys and girls do not like wet days. They cannot play outside, but must remain in the house. Mother sends them to school with strong boots, thick coats, and umbrellas, so that they may not get wet.

But the rain is very useful to us in many ways. Suppose we try to learn something about it to-day.

II. Form of Clouds

1. Where is the rain coming from? **From the clouds.**



FEATHER CLOUDS

Where are the clouds? The clouds are **in the sky.**

What colour is the sky to-day? It is **a dull grey** colour.

Is it always this colour? No; it is sometimes **a beautiful blue** colour.

What do we then say about the sky? We say it is **a cloudless sky.**

Why is it dull and dark now? Because it is **covered with clouds.**

Lead the children to tell that the clouds are piled up so thick and close together to-day, that **we cannot see the sun's bright light through them,** *nor feel any of its warmth. The clouds shut it away from us altogether.*

We call clouds of this kind **rain clouds.**

HEAP CLOUDS.

2. But the clouds are not always the same as we see them to-day. It is only in rainy weather that they **cover the sky** as they do now.

We can almost always see **little white patches of cloud,** dotted over the blue sky on a clear, bright day, and they look like patches of **loose white wool** or **feathers.** Clouds of this kind are known as **feather clouds.**

3. Sometimes, although the weather is fine, we see **great**

LAYER CLOUDS

curly masses of thick dark clouds moving across the sky These are called **heap clouds.**

STORM CLOUDS

4. Sometimes too the clouds, instead of being piled up in

curly masses, **stretch across the sky, low down, in beds or layers.** These we call **beds of cloud.**

Show pictures of these different clouds if possible.

5. Then too we sometimes see a great black cloud, as black as ink, come up and spread itself out, till it covers the whole sky. Then all of a sudden there comes very heavy rain, and perhaps lightning and thunder with it. This we call a **storm cloud.** (*See* EDUCATION DEPARTMENT CIRCULAR.)

Remind the children that the rain from the grey clouds, which they can see in the sky now, has been falling all day long. The rain from those **inky black clouds,** *although very heavy, is soon over. We call it* **a storm.**

III. What Clouds are made of

Now I daresay you would like to know what the clouds are made of. I will make a little cloud for you, and then you will be able to see for yourself what a cloud is like, and what it is made of.

1. *The kettle, which to save time has been simmering all this while somewhere out of sight, should now be brought forward, and made to boil over the spirit-lamp.*

Call attention to something new coming out of the spout.

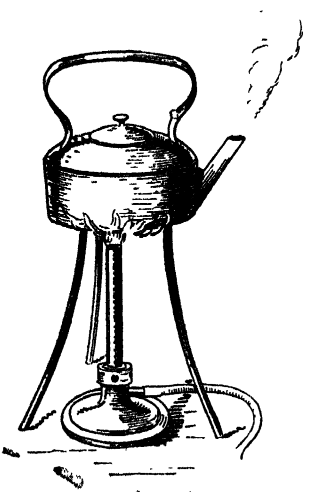
What is this called? What colour is it? What is there inside the kettle? Where did this steam[1] come from?

The steam, which you see coming out of the spout, is made from the water in the kettle. **It is a little cloud.**

[1] Of course it is not absolutely correct to call this white cloud steam, for real steam is invisible. But here we have another instance where it is better to meet children on their own platform, and be content with taking one step at a time. They know it as steam. Further explanations can come later on.

2. What has changed the water into this little cloud of steam? The **heat** of the flame.

How long will the steam rush out of the spout in a cloud like this? Till all the water in the kettle **has boiled away.**



3. Now I want you to notice what happens when I hold this wet slate in front of the fire. You see there is **another little cloud rising from the slate,** just like the steam which is coming out of the spout of the kettle. (*See* EDUCATION DEPARTMENT CIRCULAR.)

What is causing this? The **heat of the fire** is changing the water on the slate into **a cloud.**

How long will this go on? **Till the slate is quite dry.**

4. Do you know what would happen if I stood the wet slate out in the hot sun? The slate **would soon get dry.**

Why would it get dry? Because **the water on it would be changed,** as the water on this one was, and then it would **fly away in a cloud.**

What would change it? The **heat of the sun.**

Yes; heat always changes water into the form of cloud in this way.

Tell of the sun's great heat, and its action on water everywhere. It acts just as it would on the wet slate. This is how all the clouds in the sky are formed.

IV. Why the Clouds Float in the Sky

1. Watch the steam as it still pours out from the spout of the kettle.

What becomes of it? It **rises** and **floats away** up to the ceiling.

I will now tilt the kettle till some of the water flows out at the spout.

What becomes of the water? Does the water float up into the air in the same way? No; the water flows or **pours down** into the basin.

Why does the steam rise and float about in the air? Why does the water flow down?

2. *Remind the children of their lesson on "Things that Float," and let them tell that things float in water because they are lighter than the water. Be careful to impress upon them* (1) *that such things float* **because the water is heavier than they are; it presses upon them and forces them up.** (2) *That other things sink* **because the water is lighter than they are,** *and cannot press upwards with as much force, as the weight of these things presses downwards.*

3. Let us next find out what all this has to do with the cloud of steam from the kettle. We have seen the steam float up in the air just as other things float in water.

Can you tell me now why it floats? **Steam** must be **lighter than air. The air presses upon it and forces it up.**

And why does the water from the spout pour or flow down? Because water is heavier than air, and the air cannot hold it up; the water sinks through the air, **just as heavy things sink through water.**

Then why do the clouds float in the sky? Because they are lighter than the air; **the air pushes them up.**

Summary of the Lesson

1. There are feather clouds, heap clouds, layer clouds, and storm clouds.
2. Heat changes water into cloud.
3. Clouds float in the sky because they are lighter than the air.
4. The heavy air presses the light cloud up.

Lesson V

THE WIND

The teacher will require a couple of elastic bladders, and the contrivance described below in Section IV. for producing a current of air.

I. Introduction

Selecting, in this case again, if possible, a suitable day for the lesson, the teacher would begin with some remarks about the weather. The wind roaring outside, or whistling down the chimney, or swaying the branches of the trees to and fro, would naturally serve as a pretext for calling attention to what was going on.

What is the meaning of all this noise? or, Why are the trees bending over from side to side like this? The wind is doing it all. Let us see what we can learn about the wind.

II. What Wind is

1. Look how the blind is flapping about at the open window. Is the wind doing that, too? Yes.

But where is the wind? I cannot see it. I can see the blind moving about, but I cannot see the thing that

is moving it. Can you see it? No; **we cannot see the wind itself;** but we can see the things sway about, as the wind pushes up against them.

What do we say the wind does to the things? **It blows them about.**

2. *Lead the children to tell how the wind blows their clothes about, and snatches their hats and caps off their heads, as they run to school. They cannot see anything near them, but all in a moment their hats are blown across the road, and they have to run after them to get them again.* **We cannot see the wind itself,** *but we can see what it does.*

3. *Let them tell, further, that although they cannot see the wind,* **they can feel it blowing in their faces,** *and all round them. It sometimes blows so hard against them that it makes them run; and it sometimes knocks them down. It is sometimes so strong that it breaks off the branches of the trees, and even blows trees down.* **We can feel the wind, although we cannot see it.**

4. But in this warm schoolroom, and in our beds at home, we cannot even feel the wind, and yet we know it is blowing. How is this? **We can hear it.**

Tell how the wind roars and howls round the house at night; how it rustles among the leaves and branches of the trees; how it whistles through the key-holes of the doors, and down the chimneys. We hear all this. Our ears tell us what our eyes cannot tell us. **We can hear the wind, and we can feel it, but we cannot see it.**

What can this wind be, which we hear and feel, and yet cannot see?

5. *Remind the children of their lesson on Air, and lead them to tell that there is* **air everywhere**—*that there is air in this room, although we do not seem to know it is here; we do not feel it,* **till we wave our hands about through it.**

What did the air do to the pieces of paper and the

feathers when we waved the fan to and fro near them? It **blew them about.**

What did it do to the little toy ship on the water? It **blew the ship along.**

Explain that in both cases **we made the air itself move,** *that it was the moving air which moved the other things, and then tell that* **when the air moves about** in this way **we call it wind.** Let us find out next how winds are made.

III. Warm Air Rises

1. *Take two small elastic bladders and partly inflate them with air. Then after tying the mouth of each securely call some child to the front, and let him hold one of them by the string in front of the class, the teacher holding the other in a similar way near the fire.*

Notice that the one in front of the fire soon begins to swell up, and become much bigger than the other. Tell the reason why.

The air inside this bladder has been heated, and the heat has made it spread out and fill the bladder. **Air always spreads out when it is heated.**

2. *Notice too that this bladder now seems to want to rise and float in the air, and point out that it did not attempt to rise when it was first held in front of the fire. The other one held by the child hangs at the end of the string without any signs of rising.*

Let us try to find out the reason for this.

Why does the steam from the kettle rise and float in the air? **Because it is lighter than the air,** and **the air forces it up.**

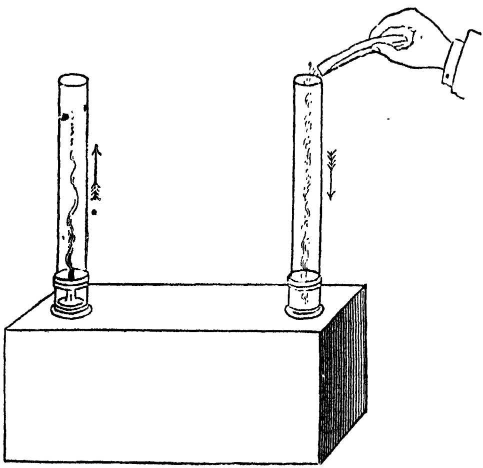
The children will be easily led to infer from this that the bladder which wants to rise **must now be lighter than the air,** *or the air could not force it up. Why should this one be lighter than the other?*

Explain that air not only spreads out when it is heated, but it also becomes lighter, **because the same quantity has to fill a bigger space.**

The warm air inside this bladder is lighter than the air of the room; the heavier air of the room is trying to force it up.

IV. How Winds are Made

1. *A very simple little contrivance will now make the whole*



thing quite clear to the children. A small wooden box and a couple of lamp-glasses will be all that is wanted.

Such a box could be easily obtained from the grocer or provision dealer. A baking-powder or blacking box would do admirably.

Have the lid removed, and cut a couple of round holes in the bottom, near the ends, exactly the size to receive the two

lamp-glasses. Fit the glasses into the holes, and place a lighted candle under one of them.

2. *As the candle burns, hold a piece of burnt paper, or some other very light substance, over the top of this glass, and at the same time let one of the children hold a piece of smouldering rag over the top of the other.*

Two things will now be clearly seen. The smoke from the smouldering rag **will be drawn down the one glass,** *and the light substance held over the top of the other* **will be carried upwards.**

Why is the smoke passing down this glass? Why are the little bits of burnt paper flying up from the other? **It is the air which is moving,** and it makes these other things move.

We must find out why the air is moving.

Elicit that the flame of the candle must make the air inside the glass hot and light—**much lighter than the air of the room**—*and then the rest will be easily deduced.*

The air inside the box itself, as well as the air in the room, is heavy, and **this heavy air is pressing against the light air in the glass,** and forcing it up.

All the time the candle is burning in one glass, air from the room is constantly rushing down the other **to push the light air upwards.**

3. *Explain that we have been making a wind in the box—we have been* **setting the air in motion.**

All winds are caused by the air in some particular place getting very hot and light, and then **the colder, heavier air near it presses upon it, and forces it to move.** It is a struggle between the heavy air and the light air, and the heavy air wins by forcing the light air away.

SUMMARY OF THE LESSON

1. Wind is moving air. We can feel it, although we cannot see it.

2. Warm air rises, because it is lighter than cold air, and the cold heavy air forces it up.

3. When the air moves it moves other things. We say the wind blows them.

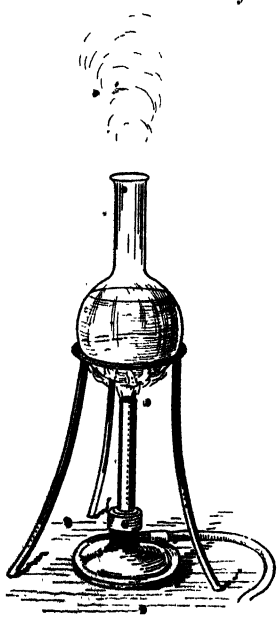
Lesson VI

CLOUDS AND RAIN

Provide a small flask, Bunsen burner and tripod stand, a jug of water, a glass prism.

I. Rain from the Clouds

1. *Boil some water in a flask over the Bunsen burner or the spirit-lamp, and as the cloud flies off from the boiling water, call special attention to the fact that there is nothing at all to be seen in the mouth of the flask itself, and for some little distance above it.*



The cloud does not show itself till it reaches the air of the room.

Hold one hand in this cloud, and pass the other (rapidly of course) between the cloud and the mouth of the flask.

Why did I draw my hand back so quickly? Because the steam would scald it.

But I cannot see anything at all round the top of the flask. There is a big cloud just above it, where I am still holding my other hand, but that is not being scalded. Where is this scalding steam?

2. *Explain that the steam, when it first rises from the boiling water*, **is as hot as the water itself.** *It would scald us badly. That is the real steam, and* **we cannot see it** *as it comes from the flask*, **because steam itself is invisible.**

Hold a cold slate in the midst of it, and show that it **turns into actual water again,** *as soon as it touches the slate. Call attention to the drops of water, as they trickle down it.* Steam changes into water as it cools.

The white cloud, in which I am still holding my hand, is steam that is **already changing back into water.** We do not see it till it begins to change, and then **it is no longer actual steam.** This little cloud is not really steam, but **water-vapour.**

It is **water-vapour,** not steam, that we see flying out **from the funnel of the railway engine.** It is **water-vapour** that **forms the clouds** in the sky.

The air of the room, although not cold enough to change this steam into drops of actual water, is sufficiently cold **to make it begin to change,** *and in that state it becomes* **water-vapour which we can see.**

Hold the hand again in the cloud above the flask for a short time, and let the children see that, when it is removed, **it is quite wet. The water-vapour has made it wet.**

3. This water-vapour is **so much lighter than air,** that the air forces it up, and **it floats about in the sky as a cloud.** But when it gets cold, the little particles of vapour run together, and are **changed back again into water,** just as we saw them changed on the cold slate.

Water is heavier than air, and therefore cannot float in the air. It sinks, and **falls down to the earth as rain.**

II. The Wind and the Clouds

Pass on next to consider the clouds in the sky once more. They are not all the same shape and size. They are always

changing. Sometimes they are in **little patches,** *sometimes they are* **piled up in great heaps.**

They do not always remain in the same part of the sky. They move about, and **it is the wind that blows them about in the sky.** *We may sometimes see the clouds* **driving onwards** *so quickly, that they almost look* **as if they were chasing one another** *through the sky.*

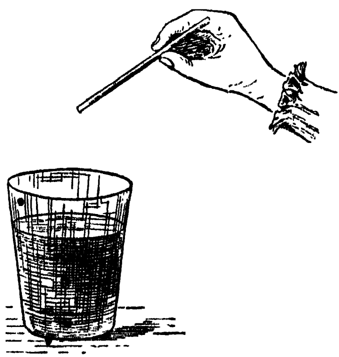
Then we see **one cloud break into another,** *and change its shape, as they drive on together. Sometimes they move slowly; sometimes they scarcely seem to move at all. Elicit as much of this as possible from the children's own observation.*

The wind does it all. It drives the clouds from one part of the sky to another. **The rain does not all fall in one place.**

III. Rain-drops

Lead the children next to describe, in their own way, how the rain falls.

It does not fall in streams, as they have seen water



come out of a spout or a tap. **It always falls in little drops.**

Dip a stick in a tumbler of water, and hold it up for the children to see the drop of water hanging at the end of it. Shake the stick, and ask them to describe the shape of the drop of water that falls from it.

It is **round like a ball.** It is **a little round ball of water.** The rain always falls in little round balls of water like this. We call them **rain-drops.**

N.B.—*It would be well, in connection with this, and on the first opportunity, to catch a few rain-drops on a dusty board, so that the children may note for themselves* **the size and shape of the drops,** *as they roll about in the dust.* (*See* EDUCATION DEPARTMENT CIRCULAR.)

IV. THE RAINBOW

The phenomenon of the rainbow should form an interesting sequel to this subject, but of course it will require the simplest of treatment, and, if possible, it should be taught from actual observation.

1. **Observation.**—*Rainbows are often seen* **in the spray of cascades** *and* **fountains,** *when the sun is shining on them; and in suitable weather it is easy to make a bow* **with an ordinary garden-hose** *during the watering operations. Under favourable conditions the thing might even be done in the playground with the help of the school-keeper's flushing-hose.*

In either case, the hose should be fitted with **a fine rose-nozzle,** *and the experiment should take place* **on a bright, sunny afternoon,** *and* **as late in the afternoon as possible.**

When all is ready, turn on the water and play the hose high, so as to cause the falling drops of water from it to **pass through the direct rays of the sun,** *and a rainbow will at once appear.*

Call attention to the succession of colours—**red, orange,**

yellow, green, blue, indigo, violet. *When there is only one bow,* **the red arch is above** *and the violet below. But sometimes there are two, and then the colours are reversed.*

Notice that the bow is **directly opposite the sun**, *that the sun is behind us as we look at the rainbow.*

2. **Explanation.**—*Let one of the children hold a glass prism in the sunlight now in front of a sheet of paper, and show that we get* **the same seven colours, in the same order.**

Tell that these colours are formed by the sun shining on the glass, and on the drops of falling water.

Remind the children of the shape of the drops of water. They are always round, or **ball-shape.**

Tell that it was **the roundness of all those little balls of water** *which gave our rainbow its beautiful arched shape. It is* **the roundness of the rain-drops,** *which fall from the clouds, that makes the rainbow in the sky.*

On the first fitting opportunity that follows be careful to point out that the position of the rainbow is not always the same. It is **sometimes very high** *in the sky,* **sometimes low down** *near the earth.*

Tell that the **nearer the sun is to the horizon** *the larger and higher will the rainbow be.*

Rainbows are **only seen in the morning and evening**—never when the sun is high up in the sky as it is at noon. (*See* EDUCATION DEPARTMENT CIRCULAR.)

SUMMARY OF THE LESSON

1. Vapour changes again into drops of water when it gets cold.

2. Water is heavier than air. The drops of water cannot float in the air. They fall as rain.

3. The wind blows the clouds about from one part of the sky to another. Hence the rain does not all fall in one place.

4. Rainbows are formed by the sun shining on the round rain-drops as they fall from the clouds.

Lesson VII

WHAT BECOMES OF THE RAIN

The following articles will be required for illustration: a towel, a large dry sponge, a piece of sea-weed, and some damp salt. A saucer of water should also be placed on a shelf in the room, a day or two before the lesson, and the attention of the children should be called to it at the time.

I. Some of it Flows away

Picture a heavy shower, and lead the children to tell, from their own observation, how **the rain-water collects in the gutters** *at the sides of the road, and* **flows away towards the drains.**

Point out that the heavier it rains, and the more the ground slopes, **the faster the water flows.** *We can see how fast it flows by dropping a piece of stick, cork, or paper into it.*

Why does the water flow along the gutter in this way? Because water is a liquid, and liquids cannot flow up: they always flow down to the lowest level.

Do not go beyond this for the present.

II. Some of it Sinks into the Earth

1. Now let us think about the garden-beds after a shower of rain.

We go out when the rain is over, and we find it is nearly all gone.

What becomes of it? It **sinks into the ground.**

Why does it sink into the ground? **Because the ground is porous.** The water soaks through its pores.

2. *Point out that this does not take place only in the soft soil of the garden-beds—that* **even the hard gravel paths and**

the roadways are porous, *and allow the rain to soak into them.*

We see **puddles of water standing everywhere** after the rain, but they sooner or later disappear, and some of this water soaks into the earth. It does not disappear so quickly on the paths and roadways as it does on the garden-beds, because they are not so porous as the soft soil—that is all.

In some places we see **puddles of water standing for a very long time.** The water cannot soak into the earth. Why is that? Because the ground there is made of clay, or something like it, which is not porous, and **will not let the water pass through.**

III. Some of it becomes Vapour

1. *Dip a towel in water, wring it out, and hang it in front of the fire.*

Dip a slate in water, and let one of the children hold that in front of the fire too.

What do you see? **A little cloud** rising from the towel and the slate.

What does that mean? It means that the water which wets them is being **changed into water-vapour;** the water-vapour makes the cloud which we see.

How long will the cloud rise like this? Till the towel and the slate become dry again, and there is no more water in them to change into vapour.

2. *Compare the towel to the* **wet clothes hanging out to dry on the clothes'-line,** *and the slate to the* **roads and pavements after a shower of rain.**

Both get dry, because the water in and on them passes off in the form of **water-vapour,** which floats away in the air. (*See Education Department Circular.*)

Watch the cloud of vapour rising from each of them. We lose sight of it as it floats away in the air. Let us find out next what really becomes of it.

3. *Dip a dry sponge in water, and let the children observe and tell that it very quickly* **sucks up or absorbs every drop of the water.** *It is* **porous.**

Explain that the air acts very much in the same way as the sponge. **It sucks up or absorbs water-vapour,** *as greedily as the sponge sucks up water.*

The wet clothes on the line and the wet pavements after the rain become dry, because the water which wets them **is changed into vapour, and the vapour itself is sucked up by the air.**

IV. Vapour in the Air

1. *Point out that we saw the vapour when it first rose from the wet towel and the slate, but we lost sight of it as the air absorbed it,* **because the particles were so scattered through the air, that they became invisible.**

There is always some moisture in the air, although we cannot see it. Wherever water is exposed to the air, **it changes little by little into vapour,** and the vapour is sucked up by the air.

2. Sometimes more vapour rises than usual, and we then see it in the air all round us, in the form of **fog or mist**; but when there is only a small quantity of vapour in the air, it becomes scattered and **the wind blows it away to form clouds in the sky.**

We see this water vapour in the sky again as cloud, because as it gets colder and colder **it collects in dense masses.**

Much of the rain which falls to the earth disappears in this way. It is **changed into vapour,** and **absorbed by the air** to form either **mist, fog,** or **cloud.**

3. *Point out that sometimes the wet clothes and the wet pavements dry very quickly, and at other times they remain wet for a long while.*

Why is this? Let me show you.

Wet the sponge thoroughly, and stand it in a saucer of water as before, calling upon the children to tell what they observe.

What happens this time? **The water does not leave the saucer,** and pass up into the sponge as it did before.

Can you tell me why? **The pores of the sponge are full of water; it can hold no more.**

4. *Explain that it is exactly so with the air.* **Sometimes the air is dry,** *and it then* **sucks up the water-vapour very quickly.** *When this is the case the wet clothes and the wet pavements soon become dry.*

Sometimes the air is so full of moisture that **it can hold no more,** *and then the clothes and the pavements remain wet for a long time, because the air cannot suck up the water-vapour from them.*

5. *Take down the saucer from the shelf now, and explain that when it was put on the shelf* **it was full of water.**

The saucer is now quite dry. What has become of the water? It has been **changed into vapour,** and **sucked up by the air.**

What shall we say then about the air of this room?

The air must be dry, **because it sucks up moisture** quickly.

6. *It would be interesting to keep a* **piece of sea-weed** *hanging up in the schoolroom, so that the children might note for themselves the changes that take place in it from time to time. One of the long ribbon-like leaves, that are so plentiful on the sea-shore, would be best for this purpose.*

In dry weather *the leaf appears* **hard and stiff**; *when the* **air is moist** *it is* **soft and pliant.** *Tell the reason for this, and, as a further illustration of the same phenomenon, show a piece of salt that has been kept in a damp place. (See* *Education Department Circular.*)

Summary of the Lesson

1. Some of the rain flows away in streams down the gutters

2. Some of it sinks into the earth.

3. Some of it changes into vapour, and floats away in the air to form clouds.

4. When the air is very dry it sucks up water-vapour very quickly.

SIMPLE OBSERVATION OF THE SURFACE OF THE LAND

Lesson VIII

TOWN AND COUNTRY

The pictures of town and country scenes should be in readiness for the lesson.

The teacher should in every case make the school and its immediate surroundings the starting-point for this lesson, and the daily run to and from school will provide the best of all introductions; for it must be remembered that the child's own little world is to a large extent confined within these limits.

Led by the teacher, his memory will be awakened, and he will readily recall things which, till now, may have been passed by almost unnoticed. This in itself will have the effect of arousing and stimulating the faculty of observation; for it will show the child that there are objects of interest everywhere, if he will only use his eyes and look for them.

The country-bred child would afterwards listen with as much open-eyed rapt attention to the teacher's skilful word-pictures of the town and its wonders, as the town child would to those which treat of the beauties and charms of the country.

The one thing to impress upon the child in either case is that, we live in a beautiful world, which is full of wonders. We ought to learn all we can about it.

I. The Town

1. *The teacher in a town school might begin by asking several of the children in turn where they live, and which way they come to school, with the view of eliciting that they live in a certain street, and that they run along other streets to get to school.*

The natural inference from this is that there must be a great many streets near the school, some leading one way, and some another.

I want to see what you can tell me about these streets.

What do you see moving along the streets as you run to school? Horses and carts and waggons.

Do boys and girls and men and women walk on the same part of the street as the horses? No; we walk **on the paths at the sides of the street**; horses and carts keep **in the middle.**

What do we call this middle part of the street, where the horses walk? **The roadway.**

What name do we give to the path because it is paved? We call it **the pavement.**

Lead the children to distinguish between the broad, flat, pavement stones—the **flag-stones,** *and the solid blocks of stone —the* **curb-stones**—*which make the border or edge of the pavement.*

These curb-stones are made of a very hard kind of stone called **granite**—much harder than the pavement stones. Why?

2. What do we see on both sides of the streets? Long rows of houses built close together.

What else besides houses? Some shops.

Some of the streets are wider than others. What do we call them? **Roads.**

Do we find houses and shops there too? Yes

What do you notice about the houses and shops in the wide roads? They are **bigger than those in the streets.**

Do we find most of the shops in the roads or in the streets? In the roads.

Why are all these shops needed? For people **to buy the things they want.**

Lead the children to infer from the number of shops and houses that, **there must be a great many people** *living near the school, and then remind them that, there are other streets and other roads stretching out on all sides, and that they too are full of houses, shops, and people.*

We call a place like this, where there are roads and streets packed close with houses and shops, **a town.** We live in a town. Do you know what it is called?

3. You have all seen the roads and streets after dark. What do they look like then? They are **lighted up**; it looks almost as bright as day.

Where does the light come from? It comes from **big lamps on the tops of tall iron posts.**

What do we call these posts? Where are they placed? Why are they so tall? Are there any other lights besides those on the tops of the lamp-posts? Yes; the shops are all lighted up.

Why? So that people may see the things in the shop windows.

Which are lighted best, the roads or the streets? The roads.

How is that? Because there are **more shops in the roads** than in the streets, and they are much bigger.

4. You spoke just now of the carts and waggons that you meet with on your way to school. What do these carts and waggons carry? **Heavy loads of all kinds of things.**

Now think of the wide roads. What do you see moving along there besides carts and waggons? **Tram-cars, omnibuses, cabs** and **carriages.**

What do they carry? **They carry people.**

When do they run? They are running all day long to take people from one part of the town to another

Which carry the greatest number of people? The **tram-cars.**

How many horses does it take to draw the omnibus? Two.

How many to draw the tram-car? Two.

Point out that the **tram-car is very much bigger and heavier** *than the omnibus, and carries more than twice as many people.*

How is it that two horses can draw this heavy car, as easily as they could draw an omnibus? Because **the tram-car runs on iron rails.** The wheels run very smoothly over these rails, so that **the horses can draw a much heavier load.**

We call the rails, on which the cars run, **the tram-lines,** or **tram-ways.**

5. *Before passing on, point out the natural inference that, as tram-cars, omnibuses, carriages, and cabs are running all day long to carry only people, there must be* **a very large number of people in the town.**

The troops of work-people *streaming out from* **some great factory** *(if there be one) in the neighbourhood, or* **the tram-cars filled with workers,** *going to or returning from their work, would enlarge upon this, and suggest that* **people live in the town, because their work lies in the town.**

Then, too, point out that these workers must have **homes to live** *in, as well as* **food, clothing,** *and* **other necessaries of life.** *Hence the number of* **houses** *and* **shops,** *and* **the crowded state of the marketing parts** *of the town.*

6. *Point out further that all the goods to be sold in the shops, as well as the things to be made in the factories, must be brought there, and the articles that are made must be carried away.*

Hence the number of carts and waggons *that we see.* **A town is a very busy place.**

II. The Country

1. *Show the picture, and proceed step by step to note the contrasts between the two scenes. It would be well to let the picture speak for itself, and lead the children, by means of a few careful questions, to seize upon one point after another.*

Comparing it with the picture of the town, elicit in the first place that, instead of the network of roads and streets, packed close with houses and shops, we have here nothing but the **green fields** *stretching away as far as we can see, and explain that the roads themselves are* **shady lanes,** *with* **hedges** *and* **trees** *on either side of them.*

2. *Call attention to the busy thoroughfare in the one picture, thronged with vehicles of all sorts, and people hurrying along in every direction, and then let the children point out that, in the other picture there are only* **two or three people** *to be seen* **working in the fields.**

Tell that there are **more people in one street** *of the busy town, than we should find in* **a long day's ramble through the country.** *Tram-cars, omnibuses, and cabs are never seen in these country roads. Why not?*

We might pass **a few carts,** and **a heavy lumbering waggon** here and there on the road, but we should not meet many people, for the few people that live there are busy in the fields.

3. *Point to the church spire peeping out among the trees in the distance, and explain that, if we walked across the fields towards the church, we should most likely find one long straggling street, with cottages dotted here and there, the school close by, and perhaps one or two little shops.*

This is where these country people live. We call the place **a village.**

4. *Explain that, if we could hear our two pictures, as well as see them, we should in one case be deafened with* **the constant noise, rattle,** *and* **bustle of the crowded streets,** *while in the other all would be peaceful and still.* **The birds singing in the trees,** *the ducks, geese, and hens cackling in the farmyard, the bleating of the* **sheep and lambs,** *and the lowing of the* **oxen** *in the meadows, would be almost the only sounds to break the stillness all round.*

Summary of the Lesson

1. A town consists of roads and streets packed close with houses and shops. It has its market-places, as well as schools, churches, and other large buildings.

2. Many people live in the town, because their work is in the town.

3. Some towns contain large factories and workshops, where hundreds of people are busy all day long.

4. A village consists of a few houses and shops, with a church and a school.

5. Only a few people live in the village, because there are no great factories or workshops there. The work to be done in the fields does not require many people.

Lesson IX

A RIDE IN THE TRAIN

Provide for illustration a good picture of the locomotive with one or two carriages attached. The modelling tray, with models of hills and valley, toy train, tunnel, etc., will also be required.

I. Introduction

The object of this lesson is to give these young children—and more especially the children of the towns—their first simple

notions of the configuration of the ground, and an imaginary railway journey, it is thought, will accomplish the purpose better than anything else

The recent chat about tram cars and omnibuses will form the best and most natural introduction to the new lesson

Commence by referring to them now, and point out that although they are very useful for carrying people from one part of the town to another, they would not do for long journeys

When people want to take a long journey how do they go? They go in a **train**

Hands up, all those who have seen a train

That's right Now I want you to tell me all you can about it

Elicit, step by step (assisting of course where necessary), that the train is made up of a **number of carriages,** *each of them bigger than a tram car that they are* **joined together** *by strong iron chains that when they are linked together in this way, they form a long line, or train of carriages, and it is that which gives the name that instead of horses they have* **a great engine** *in front which pulls them along, that they do not run along the roads of the town like the tram cars, omnibus, carts and other vehicles, but on* **roads of their own;** *that these roads, like the tramways in the town, have* **iron rails laid down on them** *for the trains to run along, and that this is why we call them* **railroads** *or* **railways;** *that they go very fast*—**much faster than a horse** *could run, and that they do not stop, as the tram cars do, for people to get in and out as they wish, but have* **stopping-places of their own** *along the line, which we call the* **railway stations.**

II THE ENGINE

1 *Show a good picture of a locomotive, and one or two carriages attached to it*

Look at the engine in front of the train We some times call it the great iron horse

Can you tell me why? **Because it draws the train along the railroad,** just as a horse draws other carriages along the roads and streets of the town.

What must we do for the horse if we want him to work for us? We must **feed him.**

Tell that this great iron horse **must be fed too.** *Call attention to the big truck next to the engine,* **piled up with coals,** *and explain that* **this is the food which the great iron giant devours.** *He could not work without it.*

Point out the furnace of the engine, where one of the men is busy shovelling in coal.

Notice how bright and red the fire looks. Tell that if this were a real engine instead of a picture, we should **hear the furnace roar,** *every time a fresh shovelful of coal was thrown*

2. What can the engine want with all this coal?

Point to the clouds of vapour flying off from the funnel of the engine. Explain that the inside part of the engine is **a boiler** *which is kept full of water, and the fire is wanted* **to boil this water,** *and* **change it into steam,** *just as we changed the water in the flask over the lamp.*

It is this **steam which makes the engine move,** and pull the train along.

It takes two strong horses to pull the tram-car along. Think how powerful this great engine must be—it does more work than a great many horses could do. **It gets all its power from the steam** of the water which is boiled in its boiler.

3. *Lead the children to describe the strange scream or cry which the horse sometimes makes. Explain that horses are said to* **neigh,** *when they make this noise.*

Our great iron horse—the railway engine—**makes a shrill, screaming noise** too, sometimes.

Can you tell me what it is like? It is like **a very loud, shrill whistle.**

Explain that this whistle is caused by the engine-driver

letting off some of the steam. **As the steam escapes, it makes that shrill, whistling sound.** *The driver does this to let the people know that the train is ready to start out of the station.*

III. THE JOURNEY

1. Let us suppose that we are going for a ride into the country in this train; that the driver has given his whistle; and that we are in our carriage with the door shut fast. The engine gives a **puff, puff, puff,** and we are off.

Now will come the opportunity for the teacher to describe the imaginary journey out of the town according to the particular locality. In one case the train will run on arches for a considerable distance, and the children may be led to form a graphic picture of the scene, as they look down upon it from the carriage windows. In another it may run along the level ground or through a cutting, and the houses will be seen above them on either side and so on.

2. *In any case it should be noted that, as the journey proceeds, the houses, instead of being closely packed, as they are near the station, are scattered more and more thinly, till at length* **the last house is passed,** *and there is* **nothing but the open country** *all round.*

Picture the train rushing on now, leaving a cloud of vapour behind it, and lead the children (those who have been in a train) to tell that it goes so fast and so smoothly that **the trees and hedges,** *and* **the tall posts** *by the side of the line,* **seem to be moving quite as quickly in the opposite direction.**

3. *Proceed to describe the nature of the imaginary country through which the train is passing.*

In one place the land is **flat and level everywhere,** *like the school playground, and the level green fields stretch away on all sides, as far as the eye can reach.*

Uncover the model now, and illustrate country of this kind, with the toy train moving along over the level ground.

We call **flat, level land like this a plain.** Some plains stretch so far that it would take a train several days to cross one of them.

4. *Continue the description with the aid of the model.*

The train still goes on, but we notice, as we look out of the windows, that **the land on either side is rising little by little,** till at last it is **much higher than the train.** We cannot see the green fields now; we seem to be shut in by a high bank on either side of us.

Presently we hear the shrill whistle of the engine, and then all of a sudden **we find ourselves in darkness.** We can hear that the train is still rushing on, **for it makes more rattle, more noise, than ever now.**

Little boys and girls creep up close to mother in the darkness, wondering what is the matter, and half afraid that something dreadful is going to happen.

But it does not last long. In two or three minutes the light begins to come again, the train makes less noise, and we find ourselves in the open air once more.

What has happened? Let me show you.

5. *Illustrate all this on the model. Move the toy train on, and show where the land gradually begins to rise.* **It is not level** *like the part through which the train has passed. It continues* **to rise higher and higher.**

Point out that where the train runs between those high banks a level road **has been cut through this rising ground.** We call this part of the railroad **a cutting.**

6. *Send the train on now through the dark hole at the end of the cutting, and let the children see it come out at the other side.*

Explain that this long hole is like the dark place through which the actual train passes. We call it **a tunnel.**

When we are in a real tunnel, we are **in a hole like**

this cut through the earth, and we have **a great mass of earth, hundreds and hundreds of feet high above us.**

Explain that it is easier for a train to travel along a level road than up a slope. That is why tunnels are cut through the earth, when it rises up into a great mass like this.

Land which rises up in a high mass many **hundreds of feet above the level country all round is called a hill.**

7. *Let the children point out the other hill in the model.*

Notice that between the sloping sides of these two hills there is a **low, hollow place**—*lower than the plain. The sides of both hills slope down and meet at the bottom of it.*

Point out that the train can only get across this low place **by means of a bridge.**

The **low land** that lies **between two hills** is called **a valley.**

Summary of the Lesson

1. A plain is flat, level land.
2. A hill is a mass of land which rises many hundreds of feet above the level country all round.
3. A valley is a low, hollow place between two hills.
4. A small valley is called a vale or a dale.

Lesson X

A SPRING

The teacher will require a rough tray, or board, with clay, sand, and gravel, and a common watering-pot, with a very fine rose-nozzle. A good picture of a spring should also be provided.

I. Recapitulation

Our last lesson told us something about the ground we walk on, and we know now that it is not all like the roads and streets of the town.

In one place it is **flat and level like our playground.**

What name do we give to this flat land? **We call it a plain.**

In another place, instead of being level, **it rises higher and higher,** so that we should find it hard work to climb to the top. When we get to the top we find ourselves **on a great mass of land, higher than the highest church steeple**—hundreds of feet above the level country all round.

What do we call a mass of high land like this? We call it **a hill.**

Then what do you understand by a hill? **A hill is a part of the land which rises very high above the flat land all round it.**

You remember too we spoke about some very low land—**lower than the plain.** Where do we find low land of this kind? Between two hills.

What do we call it? We call it **a valley.**

How is the valley formed? By the sloping sides of the two hills, which meet at the bottom. **A valley is the low land between two hills.**

II. What the Ground is made of

1. As we now know something about the surface of the ground, let us next try to find out what the ground itself is, and what it is made of.

You have all seen the ground dug up in the garden. What is this ground like? It is soft black soil in which the plants grow.

Tell that, not only the garden ground, but the green fields —**the plains, valleys,** *and* **hillsides**—*are all* **made of soil** *like this. Without it nothing would grow. There would be no green grass, no trees, no plants anywhere, because the plants feed on this soil.*

This black soil is only **the top part of the ground.**

2. Can you tell me some of the things which men find when they dig down into the earth below this soil. **Sand, gravel, clay, chalk, slate.**

No doubt most of the children have seen digging going on in different places, and they know that the men throw up to the top whatever they dig out of the hole.

Lead them to tell that they have never seen a heap of earth, sand, gravel, chalk, and clay all mixed up together at the side of the hole. In one place they may have seen a heap of sand, in another a heap of clay, and in another again they might see nothing but chalk dug out.

Explain the reason for this.

3. These things all **lie in beds or layers one under the other.** The men must dig down through one bed, before they can reach another.

Illustrate this by means of a sketch on the black-board.

Tell that in one place **the sand and gravel** *may be nearest the top, in another* **the chalk,** *and in another* **the clay**; *but they are* **always in beds or layers** *one under the other.*

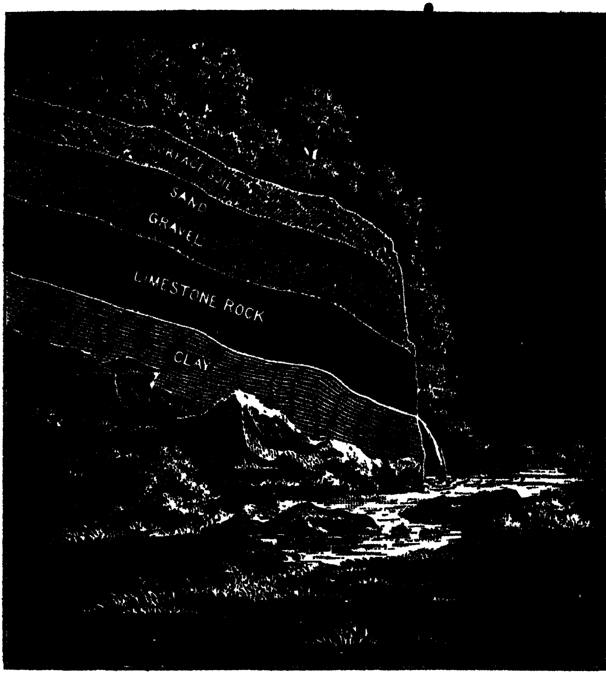
III. More about the Rain

1. We must leave all this for awhile, as I want you now to think about our old lesson on the rain, and what becomes of it.

Why does the rain fall from the clouds at all? Because, when the clouds get cold, the water-vapour changes

into drops of water. **Water is heavier than air,** and the air cannot hold it up. It must fall in rain.

Point out that the tops of the hills are so high that **they touch the clouds,** *and* **the cold earth makes the**



clouds cold. *There is always* **more rain in the hilly parts** *of the country than in flat land.*

2. *Picture the rain falling on the hills, and lead the children to tell (as far as they can) what becomes of it.*

(*a*) Some of it changes back into **water-vapour,** is sucked up by the air, and rises to form new clouds

(*b*) Some of it **flows away** down the hill-sides,

as we sometimes see it flowing down the gutters of the streets.

(c) Some of it **soaks into the ground**, because the ground is porous.

3. *Call attention once more to the sketch on the black-board, and lead the children to trace the rain, as it sinks through the beds of sand, gravel, and chalk, and reaches the clay bed.*

Why does it sink through these beds? Because they are **porous.**

What happens when the water reaches the clay? It cannot pass through the clay, **because clay is not porous.**

Explain that there are **other porous beds** *in the earth besides those we have named, and other beds besides clay which are* **not porous**. *But whatever the beds may consist of, it is always the same in the end.* **The rain soaks through the porous layers one by one,** *till it comes to something which, like the clay, is not porous, and* **it cannot pass through that.**

4. It collects there on top of the clay, or whatever it may be, till **there is not room enough to hold it all**; and at last bursts through **between the clay bed and the porous bed above,** and forces its way out somewhere through the side of the hill.

We see the water there bubbling up out of the ground, and we call it **a spring.**

5. *Uncover the tray now, and call attention to the basin-like hollow that has been made with the clay. Fill up the hollow with coarse gravel first, and sand above it, to the level of the clay-rim, and then pour water on it from the watering-pot, calling upon the children to observe what happens.*

What becomes of the water? It **soaks into the sand.**

Why? Because **the sand is porous.**

How far will it soak through? Till it comes to the clay.

Where is all the water now which we have been pouring on the sand? It is collecting on the top of the clay; **it cannot pass through the clay.**

6. *Continue to add water from the can, till some of it begins to ooze out from the edge of the clay-basin in view of the class.*

This explains what becomes of all the rain that soaks into the earth.

It rises again to the surface in the form of a bubbling spring.

Show and describe, in connection with this, the picture of the spring.

Summary of the Lesson

1. The earth on which we walk is made up of sand, rock, gravel, chalk, slate, clay, and other things.
2. These things all lie in beds or layers, one beneath the other.
3. The rain soaks through some of them, such as chalk, sand, gravel, because they are porous; but it cannot soak through clay, because clay is not porous.
4. When the water reaches the clay it collects there, till at last it finds a place where it can force its way out. It then bubbles up out of the ground and forms a spring.

Lesson XI

A RIVER

The teacher should be provided with pictures of the river and the spring, and the model of a river and its feeders.

I. Introduction

In a country like ours there are probably very few children who have not seen a river of some sort, but each locality gives its

own colouring to the picture, and so the word "river" calls up different associations in the minds of different children.

It should be the teacher's first aim to interest the children in the particular scene with which they are already familiar, and after eliciting from them all they can tell about that, it will be an easy matter to rouse their curiosity as to **what this river is, why it is always flowing on, where it comes from, why it winds about,** *and* **what becomes of it** *after it flows past their town.*

II. Rivers are Running Streams

1. If we go out after a heavy shower of rain, we find the **gutters by the side of the roadway** full of water, and we often see **puddles of water** in the road itself.

What becomes of the water in the gutter? It **flows away** to the drains.

Why does it flow? **Because the gutter slopes down,** and **water always tries to get as low as possible.**

Ask the children to notice for themselves, the next time it rains, that the water remains in the puddles long after the gutters have become dry. It does not flow away as the water of the gutter does; **it stands in the little hollows** *where it fell.*

They can easily prove this by dropping a piece of cork, stick, or paper into each. The **running stream** *of the gutter* **will carry these things along** *as it flows; but those that are put into the puddle do not move,* **because the water itself does not move.**

2. *Tell that, if we throw a stick into the river and watch it, we shall see it float away, because* **the river is a running stream,** *like the water of the gutter. It carries the stick along, as it flows; and* **it always flows in one direction, because water can only flow downwards.**

If we throw the same stick into a pond, it will remain floating where we throw it, because **the water of the pond is**

still or standing water. *It does not flow along as the water of the river does.*

III. How Rivers are Made

1. The stick would show us which way the river flows. But how could we find out where it begins, and where all this water comes from? We should have to walk back by the side of the stream in the other direction.

Explain that this would not be an easy task. It would take us many days, perhaps weeks, of hard walking to get to the place where the river begins.

Show the picture of the river. Trace the stream back as far as it can be seen. Notice that the farther we go **the narrower it becomes.** *It seems to come from those hills in the distance.*

2. *Tell that if we want to get to the* **very beginning of the river,** *we must climb one of those hills, and then we shall find, somewhere on the hillside, a place where* **water is bubbling up out of the ground.**

That of course will be quite hint enough for the children. All will be eager to tell that this water which bubbles up is called **a spring,** *and that springs are formed by the rain which soaks into the earth.*

The rain makes the spring, and **the spring makes the river. Rivers** therefore are **made by the rain** that falls from the clouds.

3. *Show the picture of the spring again now.*

Tell that this is **the beginning of the river.** *We call it* **the source of the river;** *and we say* **the river rises here,** *because the water first bubbles up out of the ground here, in the form of a spring.*

Tell too that, at the source, the river is **a tiny stream;** *we could easily* **step across it.** *We call this little stream* **a brook.**

Which way must it flow? Will it flow fast or slowly? Why?

4. *Illustrate by pouring a little water on a slate. Show that when the slate is level the water is at rest; when it is tilted even so slightly it begins to flow slowly down; and when it is tilted more it flows rapidly.*

Apply this to the stream as it makes its way down the hill side, and deduce that **the flow of the water** *down the slope of the hill must be* **very rapid everywhere.**

Picture it as it **dashes onwards** *and* **leaps from ledge to ledge.** *Compare it with the streams of water, which are seen* **rushing down a sloping roadway after a heavy rain.**

5. *Lead the children to describe the state of the road itself after the rain is all over. The rushing water makes those* **ruts and hollows in the road,** *because* **it washes away all the soft earth** *and mud, and leaves only the stones.*

The streams which flow down the hillside are **like these streams in the road.** They **wash away all the soft earth and mud,** and **dash along over the stones.**

How long will the water continue to flow down the hill? Till it reaches the **lowest ground** at the foot of the hill.

What do we call this low land at the foot of the hills? We call it **a valley.**

Explain that all rivers, after they leave the hills, **run along through the valleys,** *because the water is always trying to get to the lowest point it can find.*

Would you expect the water to flow faster or slower in the valleys? Why?

IV. How Rivers Grow

1. *Tell that, if we went for a ramble over those hills where the river rises, we should be sure to find* **other springs,** *exactly like the first, bubbling up out of the earth.*

The water from those springs **must also flow down the sides of the hills**; it cannot stand in a heap there.

Remind the children too that, some of the rain which falls on the hills does not soak into the earth, and go to form springs, but at once **begins to flow away.** *This too must flow down into the valleys* **in little streams.**

2. Let me show you next what becomes of all these little streams.

Uncover the model now. Trace the **main stream** *back towards its* **source** *among the hills. Point out the numerous* **smaller streams** *on both sides of it*—**all flowing down to join it.**

These little streams bring their water down to the big river, and every one that joins it **makes it bigger still.** We call them **the feeders** of the river, and sometimes **the tributaries.**

Explain the meaning of this term.

Point out that each of these streams—the big river and the feeders—**flows along the bottom of its own little valley,** *which is lower than the ground on either side.*

This we call **the bed of the stream—the groove or channel in which it flows.**

V. What Becomes of the River

Tell briefly that the river does not stop after leaving us—it flows on and on, getting **bigger, broader,** *and* **deeper,** *as more and more streams flow into it, and at last* **it pours all its water into the great wide sea.**

Tell that this part of the river, **where it joins the sea,** *is called* **its mouth.**

Picture the great expanse of water with the ships coming and going. The sailors on the ships often lose sight of land altogether for weeks at a time. There is **nothing but water to be seen** *all round them. This water is the sea.*

Summary of the Lesson

1. **A river is a stream of water flowing over the land.**

2. Rivers are formed from the rain. The rain makes the spring: the spring makes the river.

3. The beginning of a river is called its source.

4. The river flows because (like the water in the gutter) it is always trying to get as low as it can.

5. The little streams which flow into the river are called its tributaries or feeders.

6. The rivers flow on and on, till at last they pour their water into the sea.

LESSONS ON THE CARDINAL POINTS.

Lesson XII

ANOTHER LESSON FROM THE SUN

I. THE BOY'S SHADOW

1. *If the advice given at the close of Lesson II. has been carefully followed out, the children ought now to be quite familiar with the idea of an arch in the sky, along which the sun* **seems to make its journey day by day.**

They will have seen that every day at twelve o'clock **the sun shines exactly over the same fixed object,** *and by noting its position from time to time both before and after noon, they will have no difficulty in tracing the supposed arch along the sky. In other words, the position of the sun at* **sunrise, noon,** *and* **sunset,** *ought now to be clearly understood from actual observation.*

2. *Making this the starting-point for what is to follow, the teacher would do well to seize the first fitting opportunity of a fine sunny noon-day, and take the class into the playground for a few minutes' preliminary observation preparatory to the next lesson.*

Commence by first calling the attention of the children to the

sun in its usual position, **exactly over the well-known object,** *where they have noticed it so often before.*

Elicit that we see the sun there now, **because it is twelve o'clock, or noon;** *and that at noon the sun is* **half-way across the sky**—*it has finished the first half of its day's journey.*

Let them trace across the sky the course which the sun seems to take **between sunrise and sunset.**

3. *Call upon them to point towards that part of the arch*

where the sun rises, *and elicit that this is called the east.* **The sun rises in the east.**

Notice that the other end of the arch, where the sun sets, is **exactly opposite the east.** *We call it* **the west.**

Now place one of the children with his back to the sun, and his arms stretched out right and left.

Elicit in the first place that in this position his two outstretched arms are pointing to **the two opposite ends of the supposed arch**—*that his right hand is pointing to the* **east,** *and his left hand to the* **west.**

4. *Call attention next to* **the shadow which he throws on the ground.**

Trace it on the ground with a piece of chalk as he stands there, and show that it forms **a sort of cross** *on the ground —the four parts of the cross* **pointing four different ways.**

Lead the children to tell that one of them points **in the direction of the sun,** *another in* **exactly the opposite direction;** *another* **to the east,** *and another* **to the west.**

This will be sufficient in the way of out-door observation. The teacher will pick up the thread when the children reassemble in class.

II. North and South

1. *Commence the class-work by referring at once to the shadow-cross on the ground outside. Be careful to elicit that* **the four arms** *of the cross* **pointed four different ways**—*one* **towards the east,** *another* **towards the west,** *another* **towards the sun,** *and another* **away from the sun** *in the opposite direction.*

Call upon the children now to point out the direction in which they always look for the sun at noon.

2. Suppose we draw a chalk-line on the floor pointing in that direction.

Which end of this line points in the direction of the sun at noon?

Then in what direction must the other end point? **Away from the sun.**

Now, before we go any farther, I want you to learn two new names. Whenever we see the sun at twelve o'clock, we say **it is in the south;** the point **exactly opposite the south is the north.**

3. *Bring a child to the front again, and let him stand in the middle of the chalk-line in the same position, and with his arms outstretched as before.*

In what direction is the boy looking? He is looking **towards the north.**

What has he behind him then? **The south.**

Suppose I write **N.** for **north** and **S.** for **south** at the two ends of this line on the floor.

Remember, these points never alter, because **the sun is always in the south at twelve o'clock,** and the north is opposite the south.

4. *Remind the class that the other child stood in exactly the same position in the playground, with his back to the sun and facing the north, and lead them to tell that in each case the boy's right hand pointed to the east and his left towards the west.*

Complete the cross on the floor now, and place the letters **E.** *and* **W.** *at the ends of the cross-line to indicate* **east** *and* **west.**

Tell that these four points, North, East, South, West, are called **the four cardinal points,** *which means* **the four chief points,** *or* **the four principal points.**

Lead the children to tell that the east is the place where the sun rises in the morning; the south shows us the position of the sun at noon; and the west is the place where the sun sets in the evening.

When is the sun in the north then?

Explain that **we never see the sun in the north.** *If there are any north windows in the schoolroom they are probably without blinds. Point them out, and tell why blinds are not needed.* **The sun never shines in through those windows.**

5. You can all now find North, South, East, and West for yourselves in your own streets, or in the fields, or wherever you may happen to be at mid-day.

You have only to remember that the sun is always in the south at noon, and the rest is easy.

If at twelve o'clock in the day **we turn our backs towards the sun**, we know we are **facing the north,** and we have the **east on our right hand** and **the west on our left.**

III. The Use of Knowing these Points

1. *Proceed next to exercise the children in walking in various directions (north, south, east, and west) across the room. Then reverse the order of things and ask—*

In what direction am I walking now? What direction am I coming from? and so on.

After this it would be an easy step to deal in a similar way with a few of the streets in the near neighbourhood of the school. This would gradually familiarise the children with a fact which too often is not made sufficiently clear by young teachers—namely, that these directions, although pointed out by the sun, have to do **not with the sky,** *but with the earth on which we live.* **They show us the way from one place to another.**

2. *Remind the children that we ourselves, when we are going from one place to another, do not need the help of these points, because there are good roads everywhere, and they tell us which way to go. Then picture the great wide sea which we spoke about in our last lesson.*

The sailors in their ships are often **far away out of sight of land.** *There are* **no roads on the sea** *to guide them. They are very glad of the sun's help. They have only to remember where the sun is at twelve o'clock in the day, and they can easily find all the other points, and then they know which way to go.*

Summary of the Lesson

1. North, East, South, and West are called the Four Cardinal Points.

2. The sun rises in the east. It is always in the south at noon. It sets in the west.

3. We never see the sun in the north.

4. When we turn our backs to the sun at noon, we have the north in front of us, the east on our right hand, and the west on our left.

5. These four points show us the way from one place to another.

Lesson XIII

A LESSON FROM THE STARS

I. Introduction

1. How many of you have tried to find the north, south, east, and west for yourselves since our last lesson?

That's right. You shall now tell us how you did it.

Lead the children step by step to recapitulate the main points of the preceding lesson, and so to tell that at noonday, with the sun in the south behind them, they have the north facing them, the east on their right hand, and the west on their left.

Proceed next to show that it would be quite as easy to find these four points in the evening, **when the sun is setting,** *or in the early morning,* **when it is rising.**

2. *Ask for the position of the sun at these times, and little by little deduce the rest, so as to prove that* **the right hand stretched out towards the rising sun,** *or* **the left hand towards the setting sun** *would give us all four points exactly as we have already found them. We should in each case have the south at our back, and the north facing us as before.*

3. *In this way it would be made quite clear to the children that it is only necessary* **to fix upon one of these three points**—*east, south, or west—to find all four.*

Why not find the north first, and learn the others from

that? We cannot do this **because the sun is never in the north.**[1]

I see you know how to find these four points with the help of the sun.

Perhaps you would now like to learn how to find them at night when the sun is not shining.

II. Charles's Wain

1. What do we see shining in the sky at night, after the sun has set? The **moon and stars.**

What becomes of the stars all day long? **They are always there** day and night.

Then why don't they shine in the daytime? They shine then **just as they do at night.**

But we do not see them in the daytime. How is that? Because the light which they give is very weak and pale; **it cannot shine through the bright light of the sun.**

2. *Tell that the stars at night can help us to find the north, south, east, and west, as easily as we find them with the sun in the daytime.*

Mark on the black-board the position of the seven stars, and proceed in some such way as this:—

To-night, if there is a clear, starry sky, I want you to search it all over, till you find **seven large, bright stars** near each other in this position.

3. People have given these seven stars very curious names. Some call them **the Plough,** and they say that **the four stars** form the **plough itself,** and **the three others** in a line make **the handle.**

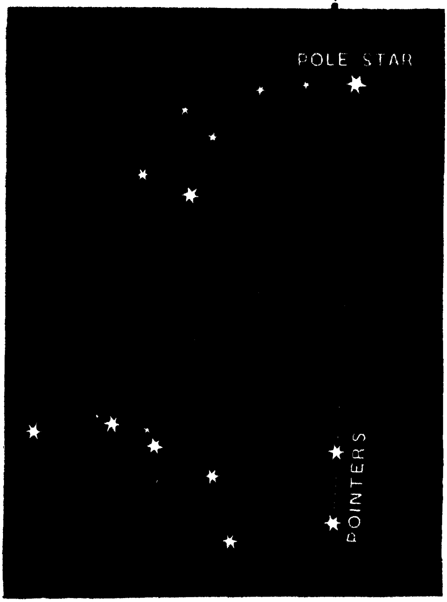
Others call them **the Waggon and Horses,** or **Charles's Wain.** The word **wain** means a **waggon.**

Others again call them **the Great Bear with a long**

[1] We are now on the level with these young children. It will be quite soon enough to enlarge upon all this when the shape and motions of the earth have been taught.

tail; but I don't think you will see much likeness in them either to a plough, a waggon, or a bear.

4. I don't mind which of these names you give them,



if you will try to remember the sort of figure which the seven of them make.

I have given each of you a piece of paper and a pencil. You may now draw them, just as I have done on the black-board, for I want you to make use of your drawing this evening when the stars are shining.

After allowing time for the children to do this, continue as follows:—

5. Now, with your drawing in your hand, I want you to search all over the sky this evening till you find these seven stars.

There are so many stars in the sky that you will not find it an easy task to pick out these at first, so I will help you.

It will be best to go to the place where you watched the sun at twelve o'clock. You remember the direction in which you found the sun then. **That is the south.** If you turn your back to this as you did then, and look up at the sky, you will soon be able to find the seven stars; for they will be exactly like those you have drawn on your paper.

You will find them **in the part of the sky which faces you,** as you stand with your back to the south.

All through the year, summer and winter, they are in that part of the sky; but in the winter you will find them **much lower down** than they are in the summer.

6. *Be careful to explain that when we have once found these seven stars and noted their position in the sky, it is not necessary for us to go to any particular place. We can find them wherever we may be.*

It will not be so hard to find them a second time, because no other set of stars make the same sort of figure in the sky. It is really very easy to pick them out, although there are so many all round them.

III. The Pointers

1. But your work will not be done when you have found Charles's Wain.

Let us have another look at the black-board.

Rule a line with a ruler **through the two end stars of the waggon,** *and continue it upwards for* **about seven times the distance,** *letting the children do the same on their papers.*

Now at the end of this line I want you to put **a very large star.** This is the star we want to find.

It is called **the North Star**, and sometimes **the Pole Star.**

2. When, this evening, you have found the seven stars, run your eye through those two end ones, up and up in a straight line, till you see another star **much larger and brighter than any of those near it.** That will be the star you want—**the North Star.**

The two stars through which we run the line upwards are called **the Pointers.** Can you tell me why? Because **they point out the North Star,** which is the one we want to find.

3. *Explain that this North Star stands* **immediately over the north part of the world,** *and that when we face it and walk towards it,* **we are walking towards the north,** *and must therefore have* **the south behind us,** *just as we had at twelve o'clock in the day.*

How shall we find the east and west then?

IV. The Use of Knowing this

Remind the children once more of the sailors in their ships on the great wide sea.

The sun is their guide in the daytime; but what are they to do after the sun has set?

The ship cannot stand still all night; it must go on just the same as in the day.

When they can no longer see the sun, **the sailors look for Charles's Wain**; that points out to them **the North Star,** and then they know exactly which way to go.

Summary of the Lesson

1. The Pole Star helps us to find the four Cardinal Points at night when the sun is not shining.

2. To find the Pole Star we must look for Charles's Wain.

3. Charles's Wain is formed by seven large bright stars, which are sometimes called the Waggon and Horses.

4. The two end stars are called the Pointers, because they point out the North Star.

Lesson XIV

THE VANE

Have in readiness the model of the vane as described in the lesson. Provide also a sheet of stiff drawing-paper and a pair of scissors for the purpose of extemporising a similar contrivance for experiment.

I. The Four Arms

1. *Produce the stand of the toy weather-cock, showing the four arms without the indicator. Notice that these four arms point in four different directions, and that they have the letters N. E. S. W. at their extremities.*

Elicit the meaning of this, and then let one of the children place it in its proper position on the table, with the north arm **pointing to the north part of the room.**

Point out that if this could be fixed up somewhere in the room, we should always know the north, south, east, and west end of the room **without thinking about it**; *and then ask the class whether they have ever seen anything like this before, and if so, where they have seen it.*

2. *There is probably* **a vane over the bell on the roof of the school,** *and if not, the children will be sure to have seen one on some of the public buildings in the place.*

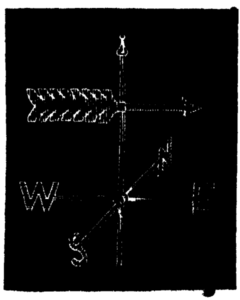
Say nothing of the name at present. We are only concerned now with those **four arms,** *fixed high up on the roof of the building, and* **pointing in four different directions,** *N. E. S. W.*

Elicit from the class that those four letters at the ends of the four arms point out to us at once, whenever we look at them, the north, east, south, and west, **without giving us the trouble to find out through the sun or the stars.**

II. The Part that Moves

1. Now I want you to look at this model on the table, and think about those you have seen on the tops of tall buildings.

Have you found out any difference between those and this one? Yes; there ought to be something on the top of the spike.



Oh! I see. *(Place the arrow in its proper position.)* Is this anything like it?

The arrow will probably satisfy some of them, but to others the figure of the bird may be a more familiar sight. Remove the arrow and put the bird in its place. Explain that sometimes one and sometimes the other is used. It does not matter which it is.

We call the four arms with the figure (whatever it may be) above them **a vane.** Perhaps some of you have watched the arrow or the bird on some vane.

Can you tell me anything about it? It is not fixed in one position like the four arms. **It moves round. It sometimes points one way, and sometimes another.**

Let us see whether our arrow is made to move round

too. Yes; you see it moves round easily with the slightest touch.

Replace the arrow with the bird, and show that **this moves round too,** *as easily as the arrow.*

Now as the four arms with the letters N. E. S. W. at the ends of them are fixed, so that they always point in the same direction, why should the bird and the arrow move? Let us try to find out.

III. Why it Moves

1. *Call one of the children to the front, and instruct him to blow as hard as he can against the bird. Observe that* **the bird at once spins round,** *and* **looks him straight in the face.**

Call upon several others to repeat the blowing from different sides of the table, and let the class see that the result is always the same. The bird each time spins round **till its head faces the child who is blowing.**

The same experiment, of course, should be repeated with the arrow, and the children will see in this case that the point of the arrow, like the head of the bird, **always swings round towards the face of the person who is blowing.**

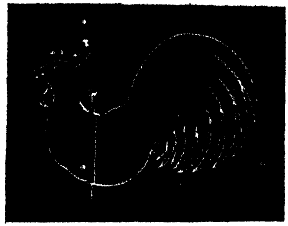
2. Have you been able to find out yet why the bird on the top of the school moves round? It must be **the wind that blows it round,** just as our breath blows this one round.

Quite right. But why do the head of the bird and the point of the arrow always face the wind? This is a puzzle which we must find out.

3. *Cut out in stiff drawing-paper a figure of a bird, exactly*

like the one that has been used, make a couple of slits in it about the middle, and fix it up on the spike.

Show that this moves round readily enough when we blow against it, **but it does not each time face the direction from which the wind comes.**



Remove it now, and make two other slits, as indicated in the sketch, **much nearer the head than the tail of the bird.** *Show that when the spike is passed through these two slits, the bird not only moves round, but* **always faces the direction from which the wind is coming.** *It cannot be moved while the wind comes from that quarter.*

Point out now that the arrow and the bird on an actual vane are both fixed to the spike **much nearer one end than the other.**

4. But we have not yet found out the puzzle. We still want to know why it is that the bird and the arrow always face the wind.

Lead the children to compare the big, broad tail-end of the bird on one side of the spike with the small, slender head on the other side, and show that there is the same difference between the corresponding parts of the arrow.

Point out that when the wind blows, **these big, broad parts catch more of it than the other parts,** *and so* **they are blown back** *as far as they will go. It is in this way that the head always faces the wind.*

N.B.—*The children should be encouraged to make a rough-and-ready paper contrivance for themselves, similar to the one just used. In doing so, point out that the one thing necessary is to make the slits nearer the head than the tail. It will then move easily round on a smooth lead-pencil when it is blown, and always face the person who is blowing.*

IV. The Wind and the Weather

1. Now tell me: When we look at the vane on the top of the school, what do we learn from it? We learn **which way the wind is blowing.**

Yes, but we learn more than that; for when we know from which direction the wind is coming, we also know **what weather we are likely to have.**

The wind has so much to do with the weather, that we sometimes call the vane on the top of a building **a weather-cock.** It points out which quarter the wind is coming from, and that is quite enough to tell us what weather is coming. Let me explain.

2. The winds which blow **from the north,** come from a part of the world where there are **ice and snow all the year round.** These are **cold, biting, freezing winds.** You know the little song that begins—

> The north wind doth blow
> And we shall have snow.

The south winds blow from the warm, sunny lands in the south where ice and snow are never seen. They bring us **warm weather.**

The east winds blow from a cold quarter of the world. They are **very dry, stinging winds.** They chap our hands and faces and lips.

The west winds come across **the great wide sea.** They are **wet winds,** because they are **loaded with clouds of vapour,** which they have sucked up from that great body of water. These are the winds **which bring the rain.**

Summary of the Lesson

1. The vane or weather-cock tells us which way the wind is blowing.

2. It is called the weather-cock, because when it shows us the quarter from which the wind is blowing, it also tells us what kind of weather is coming.

3. The north wind comes from a cold part of the world and brings us cold weather and snow.

4. The south wind brings us warm weather; the west wind brings rain.

5. The east wind is a dry stinging wind which chaps our hands and faces.

LESSONS ON THE MEANING AND USE OF A MAP

Lesson XV

PLANS

Never draw a plan on an upright black-board. It can only mislead these young children.

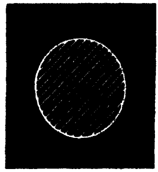
Provide for illustration two or three common articles, *e.g.* a large ink-bottle, a chalk or pencil box, and a pickle-jar; a box of coloured chalks, a large sheet of drawing-paper ruled in inch squares, and some drawing-pins; a foot-rule, and a photograph or other picture of the class-room if possible. The children should be provided with pencils and rulers, and paper ruled in quarter-of-an-inch squares.

I. Plan and Picture

1. *Place two or three common articles, such as a large ink-bottle, a chalk or pencil box, and a pickle-jar, conspicuously on the table before the class. Then without saying anything about the*

things themselves, commence to draw them roughly one by one on the black-board. While doing so proceed as follows:—

PICTURE OF THE BOTTLE.

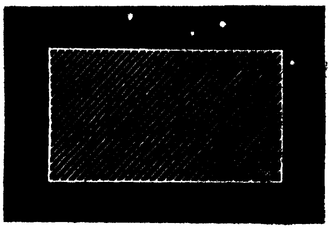


PLAN OF THE BOTTLE.

What am I drawing here? The ink-bottle.

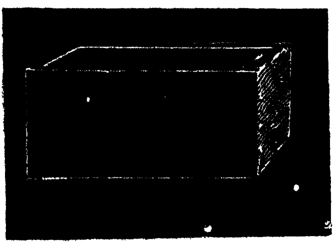
How do you know? Because the drawing is **exactly like the bottle.**

What might we call this drawing? **A picture of the bottle.**



PLAN OF THE BOX.

2. *Deal in a similar way with each of the other articles, and point out that in every case a rough picture of the thing,* **just as it appears to us,** *has been put on the black-board. We can tell at once what it is,* **because it is like the thing itself.**



PICTURE OF THE BOX.

3. *Now run a chalk-line round each of the things,* **to mark where it stands on the table,** *and then*

set the things themselves aside and call attention to what has been done.

Look at this drawing. Is it anything like the ink-bottle? No.

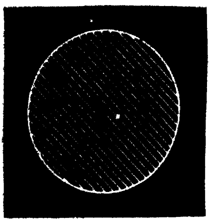
Then **it cannot be a picture** of the bottle. What is it? It is **a drawing of the bottom of the bottle**—the part which stands on the table.

What does this drawing show us? It shows us **the shape of the bottom.**

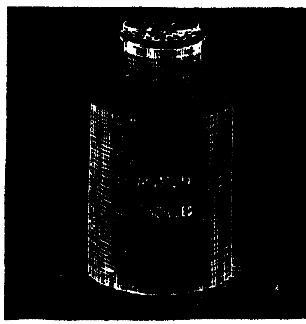
Look again. What else does it show? It shows **the size.**

Yes, and it also shows **the exact place where the bottle stood.**

Follow rapidly on the same lines with each of the other things, and then explain that drawings like these, which show



PLAN OF THE PICKLE-JAR.



PICTURE OF THE PICKLE-JAR.

the **shape** *and* **size** *of the bottom of a thing, and* **the position in which it stands,** *are called* **plans.**

4. We have here **plans of the ink-bottle, the box, and the jar,** but these plans are not at all like the things themselves. We could not say this is a bottle, this is a box, this is a pickle-jar, **because a plan is not a picture.**

Each of these plans is a drawing which shows the

shape, size, and position of that part of the thing which stands on the table—nothing more.

Suppose now I promised to show you a plan of this room. What would you expect to see? A drawing that would tell us **the shape, size, and position of the floor, and the things that stand on it.**

Well, instead of showing you a plan of our room, I am going to ask you to help me make one.

II. A Plan of the Class-room

How did we make a plan of the box and the ink-bottle? We stood them on the table, and made a chalk-line round them.

Well, we cannot of course place the room itself on this table, and yet I will show you how to make a plan of the room, which shall tell us the **shape**, **size**, and **position** of it.

1. *A large sheet of drawing-paper,* **ruled in inch squares,** *should be* **spread out on the table,** *and fastened down at the corners with drawing-pins.*

Explain that the first thing to do will be to measure the four walls of the room.

Produce the foot-rule, and proceed to measure one of the long walls with it. Show that it takes a certain number of these lengths—say twenty—to reach from one end of the wall to the other. We say **the wall is twenty feet long.**

Now measure the opposite wall, and show that this one is also **twenty feet long.**

Proceed next to measure the other two walls in a similar way, and note their length—**say fifteen feet.**

2. *Point out that it would be impossible to measure twenty feet and fifteen feet on our sheet of paper*—**the paper would be much too small.** *What shall we do?*

Call attention to the ruler itself. Show that it is marked out into **twelve parts, all the same length.**

Explain that each of these parts is called **an inch.** *We say that there are* **twelve inches in one foot.**

Now show that the sheet of paper is **ruled out into squares, exactly the size of one of these parts.**

3. Suppose we let a side of each of these squares on the paper **stand for the length of the ruler.** How many squares shall we want to show the length of the room? **Twenty squares.**

Count twenty squares on the paper, and mark off the line thus obtained in coloured chalk or pencil.

This line made by twenty squares stands for the wall of the room which is twenty feet long. We have made **one inch stand for one foot.**

How many squares shall we want to show the wall next to this one? **Fifteen squares.**

Why? Because that wall is fifteen feet long, and **one foot on the wall means one inch on the paper.**

4. *Call upon the children to point out the direction in which this line should be drawn on the paper, and then count the squares, and put in the line as before.*

It will be an easy matter to complete the figure on the paper now, by leading the children to notice that the other walls of the room are opposite these two.

When this is done, point out that we have now a drawing on the paper showing us **the exact shape of the floor of the room.**

Then if we remember that every inch in the drawing stands for a foot in the room itself, **we know the size of the room** by counting the number of inches in the drawing.

We say the figure is **drawn to scale,** and **the scale is one inch to a foot.**

5. But what else must a plan show besides shape and size? It must show **position.**

Now the best way to learn the position of our room

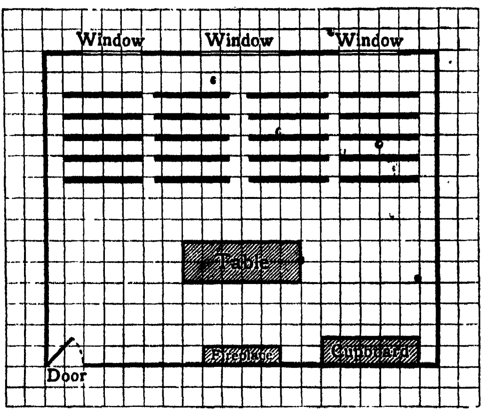
will be to find out the directions in which the four walls are built.

Very well. Suppose you all point to the north side of the room.

Now come and show me this side in the drawing.

Then if we turn the drawing round, so that **this side may face the north side of the room,** we shall at once know where to find the other three points, east, south, and west.

Let this be done, and have the four points N. E. S. W. marked on the drawing.



Our drawing now shows us position, as well as shape and size. **It is a plan of the room.**

It will be interesting and instructive now (while the plan is still lying on the table) to call upon the children to point out, on the drawing itself, the position of various things in and belonging to the room, such as the **doors and windows,** *the* **fireplace** *and* **cupboards,** *the* **table,** *the* **scholars' desks,** *and so on. These of course should all be added to the drawing one by one.*

When the plan is completed, let the children examine it, and

observe for themselves how different such a drawing looks to a picture of the room. **It is a plan, not a picture.**

It might even be possible (in these days of amateur photography) to show an actual picture of the room, and let the children compare it with the plan.

6. *It would be a useful exercise now to set the children to draw the same figure with pencil and ruler, on their own squared paper, at the teacher's dictation, counting square by square.*

When it is finished, point out that **their drawing is exactly the shape of the one on the table**—*it is* **exactly the same shape as the room.** *It is smaller than the one on the table,* **because the squares on their paper are smaller.** *But every one of their squares* **stands for a foot on the floor itself,** *and so* **we can tell the size of the room** *from the drawing. Their drawing, like the one on the table, is* **a plan of the room.** *It is* **drawn to scale,** *but it is four times smaller than the one on the table, because the squares on their paper* **measure only a quarter of an inch** *instead of an inch.*

We can make a plan to any scale we please.

Summary of the Lesson

1. A plan shows the shape and size of the ground on which a thing stands.
2. Plans must be drawn to scale if they are to show size as well as shape.
3. We can make a plan to any scale we please.
4. The four Cardinal Points are always marked on the plan to show position as well as shape and size.

Lesson XVI

MORE ABOUT PLANS

Never draw a plan on an upright black-board. It can only mislead these young children. (See last lesson.)

The teacher will require: the chalk-box of the previous lesson, a yard-stick, several sheets of drawing-paper ruled in one-inch squares, a carefully-drawn plan of the neighbourhood round the school, and drawing-pins for fixing these plans to the table or to a board placed flat upon the table.

I. Plan of a House and Garden

The real nature of a plan is so difficult for these young children to grasp, that it will be worth while to spend the time of

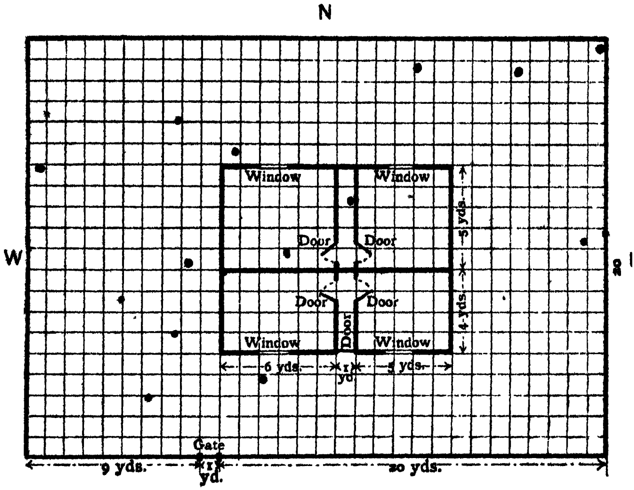
another lesson in driving home what has already been taught, before attempting to enlarge upon it.

1. *Commence by making a rough sketch of the cottage and garden on the black-board, and call upon the children to point out in the sketch, one part after another, as it is drawn—the* **door and windows,** *the* **roof, chimneys, and weather-cock,** *the* **garden fence and gate,** *and so on. Then proceed as follows:—*

This drawing shows us exactly what the real house would look like if we could see it. It is **a picture of the house.** Let us next try to make a plan of it.

You remember in our last lesson we made a plan of this box. Which part of the box did the plan show us? **The bottom of the box.**

Place the box on the table, and run a chalk-line round it as before, and then point out that the plan of the box, thus made,



really shows the **shape and size** *of that part of the table, on which the bottom of the box stood.*

Now let us think of the house. If we make a plan of this what will it show us? The **shape and size of the ground on which the house stands.** Quite right. You remember too that we next made a plan of this room.

What did we do before we began to draw the plan? We measured the length of the walls all round the room.

Well, we will suppose we have measured the walls of our house, and we find that **the front wall is twelve yards long,** and **the side wall nine yards.**

2. What must we do now? We must settle how large the drawing is to be.

How can we do that? We must **make a scale.**

How did we make a scale for the plan of this room? We said that **every inch on the drawing should stand for a foot in the room itself.**

What scale did we call that? **An inch to a foot.**

Show a yard-stick and compare it with the foot-rule. Tell that as the house is twelve yards long and nine yards wide, we should have **to move this stick twelve times along one wall** *and nine times along the other, to get the measurement of the house.*

Show the sheet of drawing-paper ruled in inch squares, and **fix it on the table as before.**

We will make our plan to-day on the scale of **one inch to a yard.**

Will that be smaller or larger than the scale we used in our last lesson? Smaller.

Why? Because **every inch will stand for a yard now**—not a foot.

3. *The rest will be very simple. Lead the children to explain how the plan is to be made on the squared paper, by counting* **twelve squares in one direction** *and* **nine squares in the other.** *Then rule in the lines with coloured chalk, and show that the oblong figure thus made is* **the plan of the house.** It shows the **shape and size of the ground on which the house stands.**

4. But is there not something else to do before the plan is complete? Yes; we must show **position** as well as shape and size.

How can we find out the position of the house? By noticing the **directions in which the walls are built.**

Call attention to the weather-cock on the top of the picture of the house. Notice that the letter S. points to the front of the house, and lead them to tell the rest. Put in the four cardinal

points by the side of the plan, and then show that our plan tells us all we want to know—**shape, size,** *and* **position.**

5. *The time would be very profitably spent in enlarging upon this simple plan.*

Tell that inside the house itself **a long passage extends** *from the front door to the back; and that there are* **four rooms,** *two on each side of this passage of such and such dimensions. Explain that our plan can show us all this.*

Measure the details out in squares according to the scale, and rule the lines in with coloured chalks as before.

The position of the **windows,** *and also of the* **doors leading to the rooms,** *might next be shown, and so on.*

6. *Lastly proceed to mark out on exactly the same lines* **the garden surrounding the house.**

Here we have a complete **plan of the house and garden.** It shows us **the shape, size,** and **position of every part,** and yet it is **not at all like the house itself** or the garden. **It is only a plan**—not a picture.

We have **straight lines to stand for walls,** and **other marks** to show **windows, doors, fence,** and **gate;** but these lines and marks are not at all like the things themselves.

II. Plan of School and Playground

This should form an important step in the teaching, but of course the teacher must, in every case, be left to his own resources. It is impossible to do more than guide him here.

He will deal with the school and its surroundings on the lines already laid down, and the children themselves should be led step by step to assist in the preparation of the plan.

A smaller scale should be employed for this—say **one inch to ten feet;** *the squared paper should be used as before; and* **above all things the plan should still be drawn on the table, and not on an upright black-board.**

III. Plan of the Neighbourhood

In almost all cases it would be impossible to draw this (as the other plans have been drawn) in and during the lesson, with any advantage to the class. The teacher should prepare beforehand a carefully drawn plan of his own, and it is very advisable that this should not be made too intricate.

1. *All that is necessary is to show the school and playground in the centre of the drawing, and a few of the main roads and streets leading from it in different directions.*

A scale of **one foot to half a mile** *would thus give a plan two feet square, and in most cases this would be found to embrace quite as much of the district as the children need be required to know.*

The teacher should take care to have **a fairly accurate knowledge of the distances of a few well-known points, public buildings, churches, and so on,** *and the rest might very well be given approximately.*

In making use of the plan during the lesson, **let it be placed, like the others, upon the table—not hung up in front of the class**—*and if necessary let the children be grouped round it.*

2. *After first seeing the plan fixed in the proper position on the table—***north pointing to north**—*call attention to the school and playground in the centre.*

Notice what a little room they take up in this drawing, and let that lead to an explanation of the new scale. This done, it will be an easy matter to deal with the details of the plan.

3. *The children will take a lively interest* **in finding their way along these roads and streets** *to and from the school, and also in telling the direction in which they are going. They will be especially interested, if one or two of their own streets are selected, and they are asked* **to show on the plan the way they come to school.**

Scores of similar devices will, however, readily suggest themselves to the teacher, to familiarise the children with the meaning and use of this plan.

4. Now let us see what this drawing really is. It shows us a square, which measures **one mile each way**. It has the school marked in the centre, the roads and streets leading from it in different directions, and it shows the churches and other buildings in their proper position.

It is a plan like the other drawings we have made; but I want you now to learn a new name for it.

This plan, which shows us **the position of different places, the direction in which they lie from one another,** and **the distances between them,** is called **a map.** It is **a map of our school, and the streets and roads near it.**

Summary of the Lesson

1. A plan is another name for a map.

Lesson XVII

PLANS AND MAPS

Plans and maps are still to be shown on a flat, level surface. They should not yet be hung up, or drawn on an upright board.

Provide the teacher with the plan of the neighbourhood used in the last lesson, the map of the river, and the model and picture of the same river as used in Lesson XI. A foot-rule will also be required.

I. Recapitulation

1. *Show the plan of the neighbourhood which was used in the last lesson, and proceed as follows:—*

What is this? A map of the streets and roads near the school.

What do you mean by a map? **A map is a plan.**

What three things does a plan show? **Shape, size, and position.**

Point out that the first of these—the shape—can be seen at a glance. The plan itself is square, and it shows all the streets and large buildings inside the square. The little oblong in the centre of the drawing points out where the school stands, and it is **exactly the shape of the ground on which the school is built.** *So of the churches and other large buildings if there be any.*

2. How do we learn the position of different places from this map? The four points—north, east, south, and west—are marked on the map, and they tell us the position of every place in it.

What else do we learn from these four points? We learn **the direction in which every road and street runs,** and the direction from one place to another.

3. Now, last of all, how can we learn the size of the place by looking at this map? The **scale tells us this.**

What is the scale for this map? **One foot to half a mile.**

What does that mean? It means that **every foot in the map stands for half a mile.**

Measure with the foot-rule north, south, east, and west from the school, and show that this square, which is only two feet across, stands for a large district round the school, **measuring one mile in every direction.**

Tell that we call this large district **a square mile.** *Our foot-rule would at once tell us* **the length of all the roads and streets** *that are marked in the map,* **and the distance between any one place and another.**

II. Map of Hills, Valley, and River

1. *Show the model of the river that was used in Lesson XI., and lead the children to tell all they can about its various features.*

When we look at the model we can almost fancy we are looking at the river itself, because we see everything as it really is.

Now uncover the plan or map of the river, which has been drawn in chalk, side by side with it, and proceed to point out the difference between the model and the plan.

The one shows everything just as it really is—the other simply tells us, **by means of certain lines and other marks,** the **position in which different things stand.** The plan is not in any way like the thing or things it stands for.

Remind the children that in our plan of the streets and roads round the school we had, in like manner, only **two parallel lines** *to show us* **a long road,** *which has shops and houses from one end to the other.*

2. This is a plan or map of the river and the land all round it. Let us see what we can learn from it.

Call one of the children to the front, and lead him, by comparing the two, to point out first of all **the wavy lines in the plan,** *which stand for* **the winding river and its feeders,** *as they are shown in the model.*

Notice that these wavy lines **are no more like an actual river,** *than the two parallel lines on the other plan* **are like a road.**

They show us exactly **how these streams run and wind about.**

They tell us **the shape of the river and its tributaries or feeders.**

3. *Show the picture of the river now.*

Call attention to the hills on either side of the river, and in the distance. Notice the trees, the grassy slopes with the sheep feeding on them, and other prominent features of the scene.

Now ask the child to point to the same hills on the plan or map.

These strange **shaded lines** are **not at all like hills** of course; but we know what they stand for, and they tell us **the shape of the land.**

When we look at a map like this, we know at once the nature of the ground. We can tell **which part of it is hilly** and which is flat.

Notice that in some places the shading is deeper and wider than in others. The reason for this may be explained and made quite clear to the children, by calling attention to the shadow which the sun throws on one side of a bank or ridge of ground which is higher than the rest.

This shading is meant to represent on our map the shadow that would be cast by these hills. The higher the hills, and the more rapidly they rise, the deeper is the shading marked on the map.

Our map tells us at a glance all we want to know about **hills, valleys, plains,** and **rivers.**

4. Now tell me: What else do we learn from a map? We learn **the direction in which one place lies from another.**

How do we find that out? By the four cardinal points.

Show these points on the map itself, and exercise the children (only to the extent of the previous teaching of course) in pointing out the direction in which certain windings of the river flow, and certain parts of the hills extend.

5. Now, lastly, a map should show us **size** as well as **shape, position, and direction.**

How shall we learn this? By looking at the **scale.**

Tell me what the scale says? **One inch to five miles.**

PREFACE

There was "a good time coming" for the children, when the Education Department wisely determined to discourage, through H.M. Inspectors, the senseless repetition of lists of names and meaningless definitions, and in its place to foster the cultivation of intelligent teaching by the natural process of observation; and under the new regime there is every prospect that our little ones will now be educated in the best meaning of the word.

Surely every teacher in the land will agree that in no subject of the school curriculum was the change so badly needed, as in the teaching of that all-important one—Geography—in its early stages.

This Scheme is intended primarily to carry out the requirements of the Code (1899) in the new Class subject, Elementary Science and Geography combined; but from its very composition, it will be found equally suitable, where geography alone is the goal ahead, and the teaching in Elementary Science will then naturally take its place in the ordinary Object Lesson Course of the school.

The Author has written with the Department's Circular open before him, and no point insisted on, or even advised in it, has been omitted.

Those lessons dealing with Common Objects and their properties provide an easy and natural series of stepping-stones, and the children are imperceptibly led by them,

and by their own observation of the simple every-day phenomena of earth, air, and water, to form clear and intelligent ideas of the world of wonders in which they live —and all this is done **without a single mention of the word Geography itself.**

Throughout the three books the Scheme is arranged in two parts—the first part dealing with Elementary Science, the second with Geography. But it should be borne in mind that this is solely for the convenience of the books, and has no reference to the step-wise sequence of the lessons themselves.

It is suggested that in each stage the lessons on Common Objects be given first, because the various matters treated therein have been specially selected to pave the way for the teaching in the Second Part; and it should be noticed that this is also the plan of arrangement in the **Children's Readers, which will follow the Manuals immediately.**

A glance through the Table of Contents below will serve to show the aim and scope of the Scheme.

The child begins **by observation of the falling rain, the gutter streams, and roadside pools,** and these become his natural teachers, which help him to form intelligent ideas of the formation of rivers and lakes.

The rain and what becomes of it forms, indeed, the key-note of much of the future teaching. The rain feeds the rivers; the rivers feed the sea. The rain even prevents the sea itself from getting salter and salter day by day.

Then, by a natural sequence, after dwelling on the blessings of the rain, the teacher introduces, at the end of Stage II., the Rainless Desert.

Another point worthy of notice is that the map of England is introduced in sections by means of sand-models at the opening of Stage III., and the child passes naturally

to notice Scotland, the British Isles, and the mainland close by—and it is not till this stage is reached that **the name Continent** is mentioned.

The word Geography (earth-knowledge)—how it is learned—and its uses—**form a fitting close to the scheme,** when it is confidently felt that the child will be prepared to take up with zest and intelligence the study of some definite parts of the world—beginning, of course, with his own country.

Amongst other aims the Author has set himself the task of endeavouring to DO AWAY FOR EVER WITH THE RIDICULOUS AND ILLOGICAL PRACTICE OF DRAWING PLANS ON AN UPRIGHT BLACK-BOARD, than which nothing can be more confusing to the young mind.

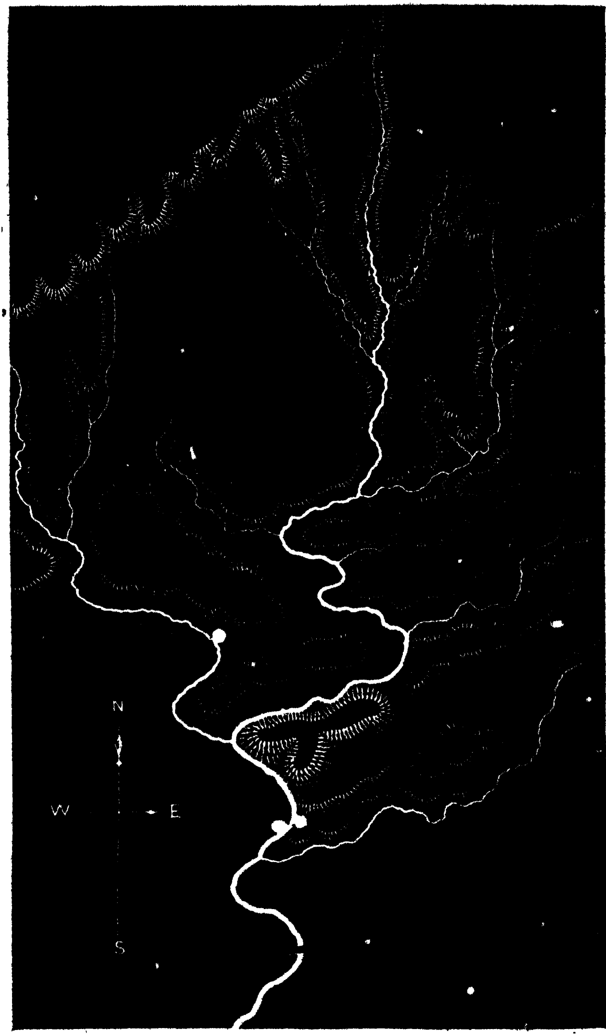
The Manuals and Readers have been prepared in connection with the Author's New Modelling Tray, Geographical Models and Apparatus, which are published by Messrs. A. Brown and Sons, and are "on file" for Patent Rights in **the British Dominions, France, Germany,** and the **United States of America.**

The **coloured pictures of the Children's Readers** are being enlarged for the purposes of **Wall Pictures for** further illustration.

The lessons provide for teaching, with the aid of these prepared models and pictures, **for modelling in clay or damp sand,** and for **the drawing of all plans on the horizontal black-board, which is formed by the open lid of the modelling tray itself.**

Not only these early plans, but **all the early maps are drawn on this black-board lid,** and hanging maps are not introduced till the children have, step by step, learned to grasp the full meaning of those drawn in the horizontal position.

The Manuals contain a large number of white-on-black illustrations for reproduction by the teacher on the blackboard, and for the special benefit of young teachers, every lesson is written in full, so that the teaching may proceed step by step, and in proper logical sequence.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What does that mean? It means that **every inch on the map stands for five miles.**

Show that, as we know this, it would be easy to measure the length of the river through all its windings, and from any one point to any other point. Our map **tells us everything we want to know,** *although it is not at all like the picture.*

6. *Call attention to* **the little town on the river,** *as it is shown in the picture; and then point out how it is represented in the map by nothing more than* **a round dot.**

Explain that this dot **stands for the whole of the ground on which the town is built,** *with all its streets and houses; but as our scale is one inch to five miles, we can only point it out in this way.*

THE END

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